DDS&T
MANAGEMENT INFORMATION SYSTEM
STUDY

PHASE I
THE OFFICE OF SPECIAL PROJECTS
(OSP)

DATED FEBURARY 20, 1968

[redacted]

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MANAGEMENT OFFICER
DDS&T

PREFACE

Although computers have revolutionized management information systems, the existance of computers tends to overshadow the importance of the interrelationships and interdependence of the management or organization structure and the information system. Traditionally, reorganizations have been accomplished without consideration of the effects on existing information systems and conversely, information systems have been designed and implemented without consideration of the effects on the management structure.

This study was accomplished with due consideration of both the management structure and the existing information systems as components of the management system.

The OSP personnel who participated and contributed to this study must be commended for their attitude and cooperation. Specifically, I would like to commend Mr. John Crowley, the Director of OSP, who rendered his full and total support so that the greatest benefit could be generated from this effort. Mr. John McMahon, the Deputy Director, emulated Mr. Crowley's support and provided valuable guidance to me during the conduct of this study.

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April 30, 1968

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INTRODUCTION

This study describes the initial Management Information System Study that was conducted within the Office of Special Projects (OSP), one of the seven offices of the S&T Directorate.

Importance of the Problem

Management activity, with due regard to the Academy of Management Theorists, is a problem-solving activity. Every manager spends more than 50 percent of his time either solving problems or contributing to the solution of problems. The act of solving a problem depends upon two elements, i.e., the manager's knowledge in the problem discipline and the ability of a management information system to provide information relevant to the problem. A management information system built on a consistent data base reflecting sound policies and procedures, operating in an organizational environment reflecting definite responsibilities and accountability providing the relevant information to decision makers can be an invaluable management tool for all levels of management. Such a system would provide more time for management to solve the subjective problems because the objective problems would have been surfaced as an integral part of the management information system.

OSP is primarily involved in the management of development programs or projects that involves all effort from the original concept through manufacture to delivery of the to the user. Such programs involve complex systems containing thousands of interdependent tasks, usually single-occurance tasks. Yet, each task needs to be completed on time, for its budgeted cost and to its specification.

Program management leans heavily on relevant information from numerous sources.

> The accomplishment of a program cannot be judged by the rate of expenditure of money, but by the achievement of successful events. We can spend or obligate money like mad, but if certain things do not happen successfully at the time that they should occur, the project is sick. Down to the smallest act which, if not performed, will cost precious time to accomplish, the project manager must know what is to happen, when it must occur, and who is responsible. By an infinity of means he can assure himself that it is happening when it should. Note the stress on "is happening," not "happened." Highly successful project management depends upon the manager knowing in advance whether a scheduled accomplishment is a yellow light far enough in advance of the red light of danger to permit taking action--bringing additional resources to bear on redirecting effort--in time to

keep the main stream flowing on schedule. [1]

The concept of a management information system never excludes personnel because it is people that not only accomplish the tasks but are an extremely important source of information.

> One of the most prevalent and most dangerous threats to successful project management is the human tendency for everyone--scientist, designer, engineer, or personnel recruiter--to keep his problems to himself until it is too late to correct the situation, even with intense application of effort and resources. This enemy must be fought every hour of everyday. The manager must instill confidence that the provision of help based on a confession of difficulty will not bring criticism or castigation. Here machines and canned techniques cannot help--only people and personal relations. Costs must, of course, be kept under control in proper fashion. The measure for this is also in the anatomy of the project schedule we have reviewed. However, cost is a consequence, not a cause, and the schedule of events is the only really effective measure of final results. If the schedule gets out of whack and cannot be enforced, costs will go off as an absolute consequence. If the cost schedule is adhered to with finality and the events do not occur, the project is still a failure. [2]

Scope

This phase of the study was limited to the Office of Special Projects (OSP) and the management information system study conducted within that office. The primary research involved interviews with selected managers in OSP and their responsible representatives to provide insights into the actual workings and relevant information requirements constituted by the present structure.

Research Methodology

The methodology of this study was divided into two phases: (1) secondary research and (2) primary research:

Secondary Research:

This phase of research involved the study of agency directives, regulations, handbooks, and headquarters notices pertinent to the delegated areas of responsibility and authority of the

[1] Maj. Gen. J.B. Medaris, US Army Ret. "The Anatomy of Program Management," Science, Technology and Management, ed. Kast and Rosenzweig (New York: McGraw-Hill Book Co., Inc.,1962), p. 127

[2] Ibid.

various levels of management in the S&T Directorate and in OSP.

Primary Research:

This phase of research involved the study of the actual structure and workings of OSP via personal interviews with selected managers and their designated responsible representatives. The purpose of the interviews was to collect data describing the actual structure, workings and relevant information requirements constituted by the present organization structure of OSP.

A preliminary meeting with the Office Director, Mr. John Crowley: (1) established the ground rules for the interviews, (2) identified the Deputy Office Director, Mr. John McMahon, as my direct point of contact in the office and (3) provided the management support so vital to the accomplishment of this study. The first meeting with Mr. McMahon provided the historical background of the office and helped to identify the individuals in OSP to be interviewed. Since I would be probing into OSP problems, a fundamental ground rule that I insisted on was to assure anonymity to those interviewed and to present the findings of this study first to OSP. Interviews were conducted during October, November, and December to tie in with individual work schedules. All of the personnel interviewed were extremely cooperative, most especially Mr. John Crowley who succintly described his modus operandi for the entire operation. Each person interviewed was asked to describe his: (1) area of responsibility, (2) the basic principles of his operation, (3) the data flow involved and (4) any problems pertinent to the study. The data gathered from these interviews were assembled and evaluated. If the preliminary evaluation revealed any discrepencies or voids of information, a second short interview was scheduled to resolve that particular deficiency and served to validate the information collected. Continued evaluation pointed to preliminary findings which were presented orally to Mr. John McMahon, Deputy Office Director, and then with Mr. John Crowley, the Office Director, in late December.

Analysis of the Primary Research

The identification of the OSP functions and responsibilities was established from: (1) the DDS&T presentation in the Introduction to Intelligence Course attended in April 1967, (2) from an office briefing conducted by Mr. Crowley in June 1967 and (3) from a preliminary interview with Mr. McMahon in October 1967. [redacted] contains a DDS&T organization chart dated 27 March 1964 that (1) does not show the

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Office of Special Projects[1] and (2) does not contain a statement of the OSP mission and functions.

The Organization Structure

The Formal Structure:

The organization charts published by OSP show a formal project structure supported by a Design and Analysis Division and a Program Administration Division shown in Fig. 1. There was no indication whether office directors had total formal authority to organize or reorganize their offices or whether DDS&T approval was necessary. Although no formal specification of OSP responsibility and mission was uncovered, there was common agreement from other sources previously cited that OSP was primarily responsible The degree of project responsibility varies within each project from total system responsibility to responsibility for subsystems as discussed later.

The Actual Structure:

Job descriptions tend to be loosely defined under Mr. Crowley's operating policy of dividing job responsibility into three major categories:

1. The position in organization implies certain responsibilities that one knows and recognizes by virtue of the position.

2. There are responsibilities that cross organization lines that will impact on immediate superiors and he must be informed of accomplishments of this nature.

3. There are responsibilities that impinge upon the individual position that are not within the authority of the individual that must be redirected to superiors.

Traditional organization theory prescribes finite definitions of responsibility via formal organization structures and function or mission statements. If organization conformed to rigid definitions, productivity would be impaired. Empirical evidence supports the existence of the informal or social organization as that entity that provides the basis for cooperative behavior. The social organization like the formal organization has standards or norms of conduct, and enforcement methods called sanctions. The norms of both may range from a definitive specification of output to what is acceptable moral behavior and what is acceptable to one may or may not be acceptable to the other.

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[1] See [redacted]

SECRET

OFFICE OF SPECIAL PROJECTS

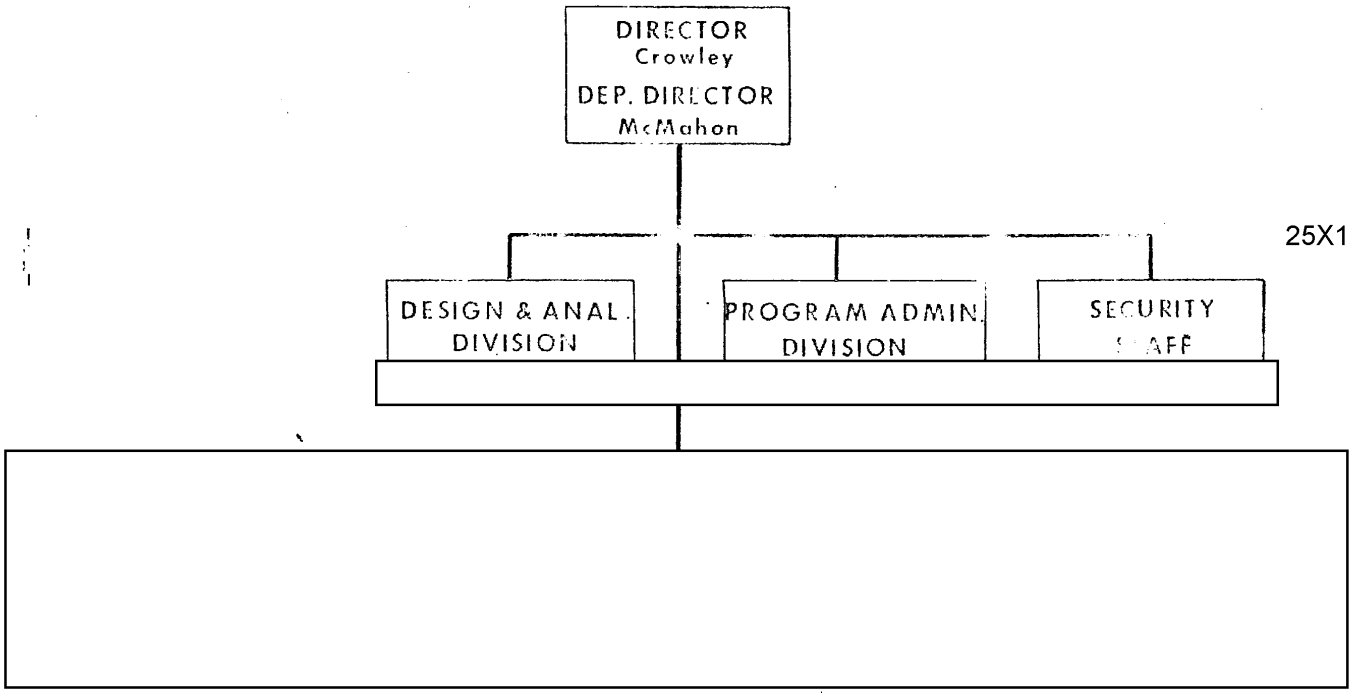

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FIG I - ORGANIZATION CHART - OSP

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The entire tenor of OSP is set by its social organization. That social organization's membership centers in the Senior Executive Committee comprised of Mr. Crowley, Mr. McMahon, 25X1 [redacted] and a Project Manager if and only if a project problem is under consideration. The executive officer is the junior member of this committee for the sole purpose of providing a freshman's point of view.

The principle of compulsory staff advice is subscribed tempered with centralized control. Mr. Crowley said, " I make the final decisions!' and "They must understand the kind of advice that I am going to accept." He practices Fayol's bridge concept of management in two ways. First, he issues orders only to the project directors who in turn relay those orders to the contractors. Secondly, he has established rigid contact levels by maintaining definite crossrank equivalence. His management philosophy consists of:

1. Know your boss well.
2. Know what he wants.
3. Get what he wants.
4. Make him like it.

Also, he rates people by these criteria. He purposely "understaffs," and his key people "stay until their job is done." He depends heavily on personal meetings with individuals as primary sources of information and prefers an informal atmosphere. He constantly monitors the progress of projects via weekly (always on Monday) project meetings which appear to be the feedback sessions for the informal daily sessions with each project director or the designated project representatives. The actual structure revolves very tightly under the centralized control of Mr. Crowley, the Office Director. He constantly crosschecks information sources to evaluate the effectiveness of his organization structure.

The Operating Environment

All contract decisions including make or buy and subcontracts are made by Mr. Crowley. All hardware decisions not impacting the funding are made in the projects. The projects are delegated the responsibility of developing their program monitored by the front office. All communications (except security messages) emanating from OSP are signed by the responsible party as authorizing official and released by Mr. Crowley or in his absence by Mr. McMahon.

The judgment factors within limits of decision-making are left to the key people and tend to vary in scope with the individual's capability to assume the initiative in his position. The effectiveness of the OSP operation depends heavily upon the

assignment of work related to the individual's ability to produce results. Mr. Crowley believes in the understudy concept of management and urges his subordinates to adopt this philosophy. He takes a sincere interest in helping his subordinates develop and attempts to provide an atmosphere similar to the Harvard Case Study tank approach applied to the real world.

The working relationships between OSP and its contractors vary over a large range extending from difficult to deal with to extremely easy to deal with. These relationships vary within projects and will be dealt with in more detail under each project section and its information system.

Each Program Director serves in the role of program manager responsible for the over-all planning, coordination and ultimate outcome for his program. As a manager, he is concerned with accomplishing specific projects that require participation by organizations and agencies outside his direct control. Working through the contractor's program managers, their authority cuts through superior-subordinate lines of authority and may often conflict with the functional managers who must share authority in their functional areas for the particular program.

The contract negotiators organizationally reporting to the contracting officer who heads the Program Administration Division prepare, negotiate, administer, terminate, and settle formal contracts and within this charter determine whether or not each particular cost is reimbursable to the contractor as an allowable item of cost.

The Management Control Center

The OSP management control center serves as a program status display room and mainly as a conference room. Summary PERT Networks, Gantt Charts, Cost Summary Charts, Line of Balance and Configuration Status Charts contain data reflecting the status of the three major projects are displayed in the control center.

The Program Controls Branch under the Program Administration Division is responsible "for the logging, assembling, posting, and display of all significant management controls information covering OSP programs."[1] The branch "shall continuously coordinate with each of the individual programs to insure that complete, accurate, and timely management controls data is received from the various contractors. ...When the necessary planning and/or reporting data specified by contracts is not forthcoming in a timely manner to the Management Controls Center, Chief, PCB shall notify the appropriate program director through his TPA

[1] See OSP-306-66 memo dated 19 October 1966, Subject: Charter, Programs Control Branch, OSP/DD/S&T, signed by Director, OSP.

(Technical Program Administrator) and the appropriate contracting officer through Chief, Contracts Branch... The continuing objective shall be the maintenance of an optimum management controls system to support maximizing management of all OSP programs.

All changes in the Management Controls System and/or the Management Controls Center, which are of a policy nature shall be made only with the approval of the Director, Office of Special Projects."[1]

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Weekly project status meetings are held each Monday in the control center [redacted] In all of the meetings attended, the groups discussed recognized problems but it was not apparent to me how the problems were discovered. Most of the problems discussed were primarily technical in nature. The impact on schedules was referred to only as dictated by the nature of the problems under discussion since no one really referred to the charts available or addressed the impact on costs.

The position of Chief of the Program Controls Branch responsible for the control center has been essentially vacant since August 1967. The responsibility for maintaining the charts has been assumed by the individual project TPA's.

[redacted]

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Total system management is a shared responsibility. [redacted] the Project Director, stated that during the development phase of this project, each of the [redacted] contractors, under contract to the agency, developed individual PERT networks of approximately 400 events. An integrated summary network of 500 events was maintained for the project staff by one of the contractors and headquarters was supplied with a summary network of 60 events. Costs were normally tied into level of effort by the project staff since the project staff knew: (1) the negotiated costs, (2) the physical progress from PERT networks, and (3) the expenditure of funds.

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[redacted] conducts a managers' meeting monthly. He maintained a problem register of the activities and subsidiary events that appeared or were in trouble. About three months before the production or acquisition phase, a shift from PERT to Line of Balance was made by the Project Staff. [redacted] maintains a detailed Line of Balance chart and forwards a LOB summary monthly to headquarters. Monthly progress reports are received by the TPA and are used to update the project charts in the control center. All fiscal data are received by the contract administrator who proofs the figures and forwards copies to the TPA and the

[1] See OSP-306-66.

Program Administration Division office. All fiscal and manpower data are supplied to the TPA by the Contract Administrator.

All of the contracts are incentive-type with penalty for overruns. The contract administrator stated that these contracts call for progress payments against deliverables, but in fact we pay actual costs reported. The contract structure was described as:

CPIF
CPIF
FPIF
[redacted] 25X1

25X1 A reserve of [redacted] is withheld on the fixed price contract until liquidation. Liquidation will start at first end item delivery. Unit costs were set on work packages at negotiation. Cost analysis is performed only on proposals and then by the audit staff. No other cost analysis is conducted by the program staff. The major problem cited by the contract administrator was in estimating the cost of engineering support, specifically engineering hours.

[redacted] 25X1

The agency project director, [redacted] stated: "(1) We don't have a 25X1
25X1 definitive relationship between [redacted] and our office; (2) the interpretation of responsibilities between [redacted] pro- 25X1
gram management and our program management are not always compatible and increases communication and (3) decisions made on areas of interface were complex, hard to define and maintain."

Mr. McMahon said, [redacted] was not convinced that a program plan was necessary. We insisted on the right of CIA to

hire a system engineer to provide technical interfaces and to assist to lay out the details of the program plan. A bitter fight developed between the systems engineering contractor. insisted on level 3 definition. CIA said level 2 with option in the event of trouble to look at level 3 and resulted in a forced management technique upon a who didn't believe it was needed. We now have using PERT--computerized. However, allows an engineer to come in a slip activities. In September (1967) (Mr.) John Crowley said that has no control over the program--get with it." In October, a reorganization of resulted in a division of engineering and program cost and schedule control.

25X1 cited the: "need for system engineering. There is a lack of capability in the contractor to understand the system requirements and (they) have a problem detecting weaknesses (in design) to get the system engineering people in these areas. This generates a need to insure currency of information supplied to the systems engineers as they investigate problems. Most of the communication is carried out by technical meetings, and every work area has two or three meetings a month. The inability to discuss classified information on the telephone generates more travel to handle problems. Our Action Item Procedure indentifies the originator and doer. Any action item effecting time or money must be approved by the project director, The contractor is controlling by PERT data--
25X1 uses down to level 3, fragnets below--used for manpower loading and to determine the impacts of shifting schedules. One of the big problems still is to get the contractor to define what the plan is.

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(We) only have milestone schedules on facilities. (We) use a milestone chart[1] as the basis for payment." This contractor is still operating under a letter contract.
25X1 stated that the contracting officer, handles approval for payment if something has been authorized. reviews 25X1 negotiations with subcontractors, gets accounting reports and checks on potential subcontractors. The majority of subcontracts in this program are of the Cost Plus Fixed Fee type.
25X1 (CPFF). said, "The proposals (submitted by) did 25X1 contain cost data." He cited the area of Special Test Equipment
25X1 originally costed at currently estimated at "The original cost estimates have given us better insights as we gained experience. We have a proposal without a work statement and lack a program plan and detailed data on test requirements The project has developed a cartoon book of the

25X1 [1] meant the over-all program chart which is a "Gantt-type" major milestone chart in the control center.

operational steps to can, uncan, checkout, and functional test . The biggest cost is [redacted] in sub- 25X1
contracts. Any procurement dollar spent is charged to an SPO number[1] pub-
lished a matrix of deliverable items vs. SPO numbers. Deliverable items were defined by [redacted] as, "deliverable 25X1
hardware plus large tasks such as management and system integration." He continued, "The Project decides the make or buy decision The project reviews the requirement, decides to go ahead, then the subcontractors come in with a work statement, the technical people will reduce the work spending a lot of time on redefining the work statements." We "play a large role in writing subcontracts for and SETS (Systems Engineering Technical Staff) writes a lot of the
25X1 subcontracts." [redacted] "spends lions share of time review-
ing subcontracts. You just don't go ahead unless you have a good work statement. Just decide on an amount and then stick to your guns." His counter to the statement, "you will hurt the program," is "show me how it will effect the program."
25X1 [redacted] receives a fiscal and manhours report biweekly which "doesn't mean a lot." Consequently, no one evaluates this report.

25X1 [redacted] the Technical Program Administrator, said, is going through their third program plan which has not been received and approved. Amendment #5 (to the letter contract) called for the Fiscal Report and the PERT Exception Report. A Technical Progress Report is required from SETS and one week after the close of books. We don't have all their budget. Can't report against the old program plan when the new program comes in then we can track the total program."
25X1 Every two weeks, [redacted] receives a PERT tab run and a second-level network chart with the critical path of each sub-assembly noted in red. The PERT tab run has the same format as
25X1 the original [redacted] run and type [redacted] input record. 25X1
This format only tracks activity times and there was no indication that costs were tied to work packages. The fiscal and man- 25X1
hours report is tied to the SPO accounts and contains the man- 25X1
hours expended and the labor, material, other direct and overhead costs incurred in the biweekly period. [redacted] stated
25X1 that, "[redacted] (Contracts Branch Chief) is not satisfied with the biweekly fiscal report. He feels he needs the ability to trace costs via end items." In mid-November [redacted]
25X1 [redacted] said that, "the bi-weekly progress reports were not in synch with the PERT runs but now are in synch." Negative replies were consistently received when the question of data analysis was asked of the personnel.

[1] An SPO number identifies a work directive within accounting structure.

In early November [redacted] Project Staff, reported on his efforts in developing the test program. He presented the test plan showing operations for each test and the major assembly operation, an over-all PERT chart, test equipment definitions and descriptions, and a line-item breakdown with manhours and operation sheets. [redacted] said there are "good people if they can get direction" and "it was like trying to pull teeth" to get done what he did. He had to dip down into the organization "below top management." 25X1 25X1

In mid-November, approximately one month after the reorganization, Manager for Program Planning and Control, reported on his organization structure and control plans. The cost structure focuses on major subassemblies. Work performed will be identified by labor codes and distributed by section within division. Total costs will be summarized for Program Management, Development Projects, and Facilities. Nine major tasks are identified under the with costs tied in with working PERT networks. The traditional historical type of cost and control charts were displayed for incremental program costs, cumulative program costs, direct labor and direct material and subcontracts. A time base PERT display that looks like a Line of Balance chart was shown plus the usual trend charts. When finished, Mr. Crowley added, "The more planning and scheduling you do, the more load you take off the engineers you don't have."

[redacted] 25X1

The agency was given the responsibility for the total system and management of this program.

25X1 The contractual documentation requirements differ for each of [redacted] contractors and will be discussed individually.

The following selected provisions abstracted from the work statement[1] cover the management information requirements cited in the contract. 25X1

[1] See Report [redacted]

3.0 Contract Deliverable Items
...Specifically the items listed below shall be delivered to the Procuring Agency in accordance with the program schedule of Section 4.

- -
- -
- -

Item 5 - Program Documentation per 6.10

5.0 Applicable Documents

5.1 Procuring Agency

[redacted] 25X1

5.2 Military Specifications

5.3 Contractor Furnished Documents
The following documents shall be incorporated in the contract when approved by the Procuring Agency.

1. Reliability Program Plans
2. Quality Assurance Plan
3. Acceptance, Qualification & Life Test Plan
4. Specification - deleted at negotiation
5. Performance Design Requirements Specification - deleted at negotiation
6. Training Plan
7. Logistic Support Plan
8. Installation, Checkout, & Acceptance Test Plan

6.10 Program Documentation
Develop, prepare, deliver, and maintain current, where applicable, the documentation referenced in Item 5 of Section 3. The Contractor-submitted documentation shall thoroughly describe the program effort set forth in Section 6.0. Documentation requirements are set forth in Section 7. Written or graphic material submitted to the procuring agency (except TWX's) shall include 10 copies of the normal 8½ by 11 inch size. In the event this is not practicable, e.g., PERT summary networks, fold-outs are acceptable. In addition the Contractor shall submit two copies of the Graphic Material described in Section 6.14.2.1 and in accordance with Section 7.5, in a size suitable for wall display, i.e., Summary PERT Networks, 6 to 12 feet by 2½ ft., Milestone Schedule Gantt-type and Cost Charts, 3 feet by 4 feet.

6.14 Program Management and Technical Coordination
The Contractor shall manage his program to achieve

the specified technical objectives in accordance with the schedule of Section 4 of this statement of work. The Contractor's management structure shall provide planning, project control, coordination and reporting as described in the following sections.

6.14.1 Program Management Plans

The Contractor shall prepare and submit program management plans describing and scheduling all phases of the Contractor's program. The program plans shall identify all significant milestones and define all tasks to be performed in response to this statement of work. Required plans are described below and listed in Section 7.

a) Development Plan

1) Program Summary. The Contractor shall describe his program in summary form; indicating his development approach and discussing critical areas, method of attack and expected outcome.

2) Description of Deliverable Items. The deliverable items description shall include a list of all deliverable items, a description of each item with its function and basic requirements, the quantity of each, and scheduled delivery date.

3) Schedules. Schedules shall include milestone charts at the system and unit levels. These charts shall cover all key events, activity time spans, and their interrelationships.

4) Task Descriptions. This document shall describe the major program tasks necessary to fulfill the requirements of this statement of work.

5) Management Plan with Manpower Loading. This plan shall describe the project organization, facilities utilization, and planned manpower loading. The plan shall also describe program control techniques, including methods for evaluating status, reporting progress, and revising management plannin

6.14.2 Program Control

The Contractor shall provide program control for schedule maintenance, subcontract management, cost, manpower utilization and security.

6.14.2.1. Schedule Control

The Contractor shall prepare and maintain the milestone charts and PERT-Time networks depicting his planned activity and progress listed below:

Items a, b, and d, shall be submitted in accordance with Section 7.5. Item c shall be submitted by the Contractor upon specific request by the Procuring Agency.

a) Summary level milestone Schedule Chart consisting of approximately 75 of the most critical activities and events.

b) Milestone Schedule Charts for each major subproject consisting of schedules similar to those depicted in Section 3 of the 25 August 1966 volume titled "Revised Cost Estimate."

c) Expanded milestone schedule charts as required to depict special areas of interest.

d) Separate PERT-Time networks depicting approximately 200 key events for both the and the system, activity time spans and their interrelationships.

6.14.2.2 Fiscal Control

The Contractor shall submit cost charts for the overall program and for each subproject. Each chart shall graphically reflect the cumulative budgeted manhours and dollars as a function of time.

6.15 Reports

6.15.1 Reports. The Contractor shall prepare and submit the following reports:

a) Technical Progress Reports. Technical progress reports shall be submitted monthly and summarized quarterly. The quarterly report shall include the activities or work performed during the last month of the quarter. The reports shall describe significant progress in the execution of all phases of the program. Changes in system performance and power budget, performance and power budget, status, and control budget shall be included. The report shall summarize the status of the program with respect to the program plans and contain

a discussion and analysis of significant problem areas. Recommendations for action to resolve outstanding problems shall be included as appropriate. In addition, the report shall include milestones scheduled for the following month. These milestones shall reference the management summary network which shall be maintained and updated as required. A list of all documents generated on this program during each reporting period shall be included in each progress report and these documents shall be available to the Procuring Agency on request. The monthly report shall be presented in the format shown in Appendix A.

b) Fiscal Reports. Fiscal reports shall be submitted semi-monthly and monthly in accordance with the format shown in Appendix B.

c) Schedule Variance Reports. A TWX report in the format shown in Appendix C shall be submitted biweekly to the Procuring Agency. This report shall list the PERT accomplishments and status by event. Reference shall be made to the management summary network. Schedule information of an analytic nature shall be included in the monthly progress report or by a separate document if it is too voluminous for a TWX report.

7.0 Documentation

The Contractor shall prepare and deliver the following documents. The documents which indicate Procuring Agency approval shall be incorporated into the contract.

7.1 Program Management Plans

The plans and documents comprising the program management plans, with required approvals and delivery dates, are outlined as follows:

Description	Delivery Date ARO	Cust. Appr. Reqd.	For Info.	Publication Date
Program Management Plans				
a) Development Plan	60 days		x	
b) Manufacturing Plan	60 days		x	
c) Acceptance, Qualification and Life Test Plan	180 days	x		
d) Material Plan	60 days		x	

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Description	Delivery Date ARO	Cust. Appr. Reqd.	For Info.	Publication Date
Program Management Plans				
e) Assembly and Integration Test Plan	60 days		x	
f) Installation, Checkout and Acceptance Test Plan	360 days	x		
g) Reliability Plan(s)	30 days	x		
h) Quality Assurance Plan	30 days	x		
i) Operations and Support Plan	360 days		x	
j) Logistics Support Plan	180 days	x		
k) Training Plan	360 days	x		
l) Configuration Management Plan	60 days		x	
m) Subcontracts Plan	60 days		x	

7.2 Specifications

The following specifications shall be prepared and delivered by the Contractor in accordance with the schedule indicated.

Description	Delivery Date ARO	Cust. Appr. Reqd.	For Info
Specifications			
a)	As required	X	
b)	As required	x	

Description	Delivery Date ARO	Cust. Appr. Reqd.	For Info.
c)			
	As required	x	
d)			
			x
e)			
			x
f)			
Preliminary			x
Final			x
1) Integration and Control Subsystem Specification			x
2)			x
3)			x
4)			x
5)			x
g)			
Preliminary			x
Final			x
1) Structures			x
2)			x
3)			x
4) Electrical Power			x
5) Communications			x

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Description	Delivery Date ARO	Cust. Appr. Reqd.	For Info.
6)			x
7) Electrical			x
8) Mechanical			x
9) Equip. Spec.			x
10) Support Spec.			x
a) Structures			x
b)			x
c) Electrical Power			x
d) Electrical Integration			x
e)			x
f)			x
g) Communications			x
h) Mechanical			x

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7.5 Graphic Materials

The Contractor shall prepare and deliver the items listed below which are further described in Sections 6.14.2.1 and 6.14.2.2.

a)	PERT Network	120 days and thereafter as required	x
b)	Master Milestones Schedule Gantt Charts	30 days with updating as required	x
c)	Major Subproject Milestone Schedule Gantt Charts	30 days and thereafter as republished by the Contractor	x

Description	Delivery Date ARO	Cust. Appr. Reqd.	For Info.
d) Overall Program Cost Charts	60 days and thereafter as required		x
e) Subproject Cost Charts	60 days and thereafter as republished by the contractor		x

APPENDIX A

STATUS REPORTS FORMAT - MONTHLY AND QUARTERLY

PROGRESS REPORTS

Technical progress data to be submitted monthly and summarized quarterly shall be prepared in the following format:

1. ABSTRACT
A brief abstraction highlighting technical progress as reported in greater detail under Item 3 of this report.

2. PROGRAM STATUS SUMMARY
A brief summarization of overall program progress with respect to the program plan.

3. SUBPROJECTS
Technical progress and work accomplished during the report period within each subproject, with subproject reports to be grouped within appropriate major functional areas of effort. Content shall include progress, trends, planning, status and discussion of major problems. Changes in system performance and power budget, and control budget shall also be summarized.

4. INTERFACE STATUS
Status of all interface efforts.

5. MAJOR PROBLEM AREAS
Discussions and definitions of major problems that, if not resolved, may result in serious delay and setbacks. Include also recommended solutions and corrective action.

6. SCHEDULE FORECAST
Major milestones scheduled for the following month, except in the quarterly report, which shall forecast schedules for

the next three months. This information shall be keyed to the current System Summary PERT Networks.

FISCAL REPORTS

MONTHLY COST REPORT*

A. Program Budget and Expenditures

	Budgeted	Actual Expended	Variance(±)
Man Hours	_____	_____	_____
Direct Labor	$_____	$_____	$_____
Material/Subcontract	$_____	$_____	$_____
Other Direct Charges	$_____	$_____	$_____
Indirect Charge	$_____	$_____	$_____
Total	$_____	$_____	$_____

B. Subprogram Budget and Expenditures

Subprogram	Budget Through Report Period	Actual Expended	Variance(±)
_____	$_____	$_____	$_____
_____	$_____	$_____	$_____
_____	$_____	$_____	$_____
_____	$_____	$_____	$_____
Total	$_____	$_____	$_____

SEMIMONTHLY LABOR COST REPORT**

Subprogram	Estimated Direct Labor & Hour	
_____	$_____	_____hrs.
_____	$_____	_____hrs.
_____	$_____	_____hrs.
_____	$_____	_____hrs.

* To be submitted 21 days following close of report period.
** To be submitted by TWX 5 working days following end of each two-week period.

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The TPA, [redacted] said, was submitting three separate level, one summary sub-system PERT networks." He only receives PERT blue prints, no computer runs, "whenever they claim they have cycled." Any minor changes are covered by the TWX biweekly procedures. "No justification is required for any reported changes and renumbered activities are not coordinated." The TPA only receives top-level networks one at a time, usually every month. The biweekly TWX's describing accomplishments and changes to the PERT networks have been of limited use, because the contractor has changed individual activity times, added events, changed event numbers, etc. at his discretion without any need for justification or coordination. When network changes have occurred, the contractor has shifted the planning base to the revised plan.

25X1

The contracting officer, [redacted] believes that "the PERT diagrams are only produced for our use. would agree only to top-level reporting during the negotiation.) The assistant program directors only have and use bar charts." cost collection system includes a matrix of "26 subprojects vs. work activities" and contains "at least 3000 [redacted] cost cells." [redacted] cannot prove the existence of product costs and does not believe that is product costing. "Each assistant program director has a bonus plan that is set as a percentage of the profitability of his individual project effort." [redacted] uses quarterly incremental funding and does not maintain any cost statistics. He believes that the "Management Control Center and the Project Staff should be comparing performance with costs incurred." Further, he said, "the fee is to be on the basis of formally executed certificate of physical completion and not a percentage of cost." When questioned about the absence of equipment status reports, [redacted] replied, "the equipment status report was deleted in the last stage of negotiation by the technical personnel because they said they didn't need it and they were there anyway."

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The following selected provisions abstracted from the work statement[1] cover the management information requirements cited in the contract:

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STATEMENT OF WORK, [redacted]

4.1 Management Plan (45 days ARO)

A management plan shall be developed and shall contain the Contractor's plan for the organizational structure and staffing necessary to provide adequate technical direction and management control of the entire program. This plan shall also define the methods to be utilized for configuration management, status control, financial control, and schedule control throughout the life of the program. As a minimum, PERT scheduling shall be used.

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[1] See Report [redacted]

4.12. Status Reports

The project status reports shall be prepared and submitted such that summary status charts may be maintained at the headquarters. The reports shall be submitted in accordance with the schedule contained in Paragraph 9.0 and shall include the following reports.

4.12.1 Monthly Technical Progress Report (EOM + 10 days)

This report shall be presented in the format shown in Appendix A and shall describe the previous month's progress, the current status, immediate plans, and in an appendix, a summary of test results covering tests performed during the reporting period. Every third monthly report will be a quarterly Engineering Report.

4.12.2 Quarterly Engineering Report (Quarterly + 10 days)

This document shall record the technical progress, findings, conclusions, and status for the previous three-month effort. Every fourth Quarterly Report will be an Annual Report encompassing the entire year's effort.

4.12.3 Summary PERT Network (90 days ARO)

A PERT network depicting approximately one hundred fifty (150) key events, related activity time spans, and their relationships shall be produced and updated monthly if changes are necessary. The chart shall be approximately 72 by 30 inches.

4.12.4 Milestone Chart (30 days ARO)

A major milestone or Gantt Chart consisting of approximately seventy-five (75) line items shall be provided and updated monthly if changes are necessary. The chart shall be thirty by forty inches.

4.12.5 Program Cost Chart (30 days ARO)

A program cost chart showing projected program cost, by month extending for the length of the program. Actual expenditures shall be submitted semi-monthly.

4.12.6 Semi-Monthly Fiscal Report (Semi-Monthly)

This TWX report shall summarize the financial status of the contractor's program, to the subprogram level, including the status of major elements of the program. The format of this report is included in Appendix A.

4.12.7 Biweekly Schedule Report (Biweekly)

This shall be a TWX report listing the PERT accomplishments and status by event. A typical format is shown in Appendix A.

4.12.8 Presentations
The contractor...
...as required or requested by the contractor.

APPENDIX A (Formats)

Monthly Progress Report

1.0 Abstract
2.0 Program Status Summary
3.0 Subproject Status
4.0 Interface Status
5.0 Major Problem Areas
6.0 Failure Summary & Corrective Action Forecast
7.0 Schedule Forecast
8.0 Documentation
9.0 Management Analysis

TWX Format
Semi-Monthly Fiscal Report

A. Program Budget & Expenditures (Cum. to date)

	Budgeted	Actual	Variance
1. Labor Hours	-	-	-
2. Labor $	$	$	$
3. Material	$	$	$
4. Other Dir Change	$	$	$
5. Indirect	$	$	$
6. Total Cost Line	$	$	$

B. Subprogram Budget & Expenditures (Cum. to date)

1.	$	$	$
2.	$	$	$
3.	$	$	$

Total Cost Line

TWX Format
Biweekly Schedule Report

Preceeding Event	Succeeding Event	Compl/Time Span	Date
1.			
2.			
3.			
4.			

NOTE: 1. Complete Items indicate Succeeding Event only, a "C" code for complete and the completion date.

2. Rescheduled items indicate both preceding and succeeding events, the new time span in weeks, and the new scheduled completion date.

has provided the following documentation to the project:

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Management Plan
Training Plan
Configuration Management Plan
Quality Assurance
Financial Plan
Equipment Fabrication & Assembly Plan
Status & Schedules Control Plan
Logistics Plan
Facility Requirements
Test & Evaluation Plan
Operation Plan
Reliability & Maintainability Plan

25X1 The Configuration Management Plan uses the baseline approach of [redacted] procedures. The financial plan describes a task-based cost system which relates contract to task to areas or organization and category of labor skill. The status and schedule controls plan lists PERT nets, subnets, program master milestone charts, Summary PERT nets, and detailed Gantt-type schedules (hardware orientated with nine equipment lists plus spares and operating supplies) as the control devices to be used in control room.

25X1 is using only PERT time, and costs are not tied to PERT-identified work packages. [redacted] he contracting officer, said, "We had to force into budgets keyed to products. is very cooperative and will supply us anything we want." This latter

25X1 fact was demonstrated when [redacted] the TPA, requested and received a PERT computer run with the PERT networks from A Comparison of the run with the nets showed a discrepancy in the slack values of the critical path for the same status date.

The management information supplied by includes the use of CPM for their construction activities. The Agency resident engineer submits a weekly progress report which is compared with the monthly progress report and the monthly CPM listing. The facilities division of the project maintains a 1000-item network and color codes the progress reported on that network. A Construction Progress Schedule of 50 activities in Gantt Chart format is maintained for the Management Control Center. supplies a monthly performance summary computer printout showing classes of labor and material within work codes by job order numbers (E.P. Numbers) a monthly financial computer printout of construction costs by building and

system, a biweekly fiscal report of manhours and planned/actual costs, and all invoices. The facilities division checks all invoices against the fiscal reports. also provides a physical facilities chart showing status of labor hours and cost variances, the usual P/A costs and manpower plots. All information necessary to maintain the charts in the control center is passed to the TPA. The biweekly fiscal report is routed through the contract administrator to the TPA.

All of the contracts and the majority of subcontracts in this program are of the Cost Plus Fixed Fee (CPFF) type. This includes the construction contract [redacted] 25X1

Design and Analysis Division

This division has well-defined functions and responsibilities.[1] 25X1 [redacted] the division chief, maintains two notebooks which contain manpower activity information and project fund status information.

The first notebook contains (1) the functions and missions of the division and branches and (2) the activity plans for every individual listing his task assignment by month for six months. 25X1 This notebook allows [redacted] rapid access to individual work assignments--"to know who is working on what."

The second notebook contains the organization charts, the table of organization by branches, a list of all projects and their funds by fiscal year and a funding summary. This notebook is related to the program planning cycle covering a one-year plan and a five-year plan.

25X1 [redacted] believes that a plan of action with problem definition should be produced "for in-house projects." This plan should include not only "written definition but also a verbal presentation and a schedule of events." 25X1

Mr. McMahon said, "DNAD is unlike the projects, smaller in scope with more numerous tenacles. It is unique, because of [redacted] and his ability to tell all in fifteen minutes. Much less demanding than the projects. [redacted] is the father of [redacted] He is the most unique technical asset that CIA has." Mr. Crowley 25X1 said, "I use [redacted] as a Chief Technical Advisor." 25X1 25X1

The functions and mission statements in the notebook were not approved by Mr. Crowley and discrepancies were noted between the responsibilities described in the notebook and the responsibilities described in the approved memorandum.[2]

[1] See Memo. OSP 0043-67, dated 8 Feb 67, Subject: Design and Analysis Division Organization and Mission.

[2] Ibid.

Program Administration Division

This division is responsible, in addition to the management control center, for providing centralized support services in logistics, personnel and contract administration. This study concentrated on the management control center previously discussed and on contract administration, because these functions reflect the effectiveness of project planning and control.

The only formal statement of functions and responsibilities for the contract branch was an undated memorandum issued and signed by [redacted] Chief of the Program Administration Division, but not yet approved by Mr. J. Crowley, Director of Special Projects.[1] The only authorized contracting officer is [redacted] The contract branch, under the broad direction and policy guidance of [redacted] is "responsible for all contractual negotiation, administration and contract settlement required for the procurement of the necessary services, material and equipment in support of approved...programs assigned to or under the purview of the Director, Office of Special Projects."[2] The branch is principally "concerned with the functions and techniques which involve the negotiation, preparation, administration, termination and settlement of formal contracts."[3]

25X1 25X1 25X1

The [redacted] contract negotiators of the branch are assigned to particular programs or projects to provide contract support to the respective program directors and their staffs. They are charged with the usual negotiation responsibilities including the liaison and coordination of contractual matters with program, project, contractor and other personnel.

The contract negotiators strongly influence the programs and the program management since they not only prepare and negotiate all contracts but also determine whether or not each particular cost is reimbursable to the contractor as an allowable item of cost in the administration of each contract.

The majority of contracts and subcontracts under OSP are of the Cost Plus Fixed Fee (CPFF) type. Historically, this is an outgrowth of the original contract experience referred to in the agency as the "skunk-works" approach to contracting. For that particular procurement, time was important and cost was no object since money was used to buy time.

[1] See OSP-632-66 Subject: Functions and Responsibilities of Contract Branch, Office of Special Projects.

[2] Ibid.

[3] Ibid.

Summary, Findings, Conclusions, & Recommendations

Summary

The primary purpose of this study is to ascertain the relevant DDS&T management information requirements for each management level, to examine the existing supply or flow of information and to establish a specification for an integrated management information system. Although automated information systems have been accorded much attention, more often than not such efforts have failed to recognize that management information systems (whether automated or not) and business organizations are actually related through the unseparable management functions of communication and decision-making. Thus, management information systems and business organizations exist and operate as interrelated elements of the overall enterprise.

To accomplish the primary purpose of this study, the following specific objectives were established:

1. To present a proposal to the DD/S&T describing the approach and benefits of accomplishing a Management Information System Study.

2. To demonstrate the feasibility and benefits of this new discipline within the Directorate by conducting a Management Information System Study within the Office of Special Projects (OSP), one of the seven offices of the S&T Directorate.

Scope and Methodology of this Study:

This study involved approximately [redacted] personnel within OSP who were interviewed over a three-month period from October to December 1967. Additionally, numerous project meetings and conferences were attended in this same time period. Data was recorded during the interviews, meetings, and conferences. Analysis and evaluation of this data was conducted simultaneously with the data gathering phase. Facts were cross-checked from at least two sources to insure validity of some data, and follow-up interviews were conducted to validate other data. Anonymity was assured to a practical degree to further assure the validity of the interview data. 25X1

Findings

The significant findings of this study are presented as they relate to: (1) the OSP organization structure and the operating environment and (2) the OSP office in general.

The Organization Structure and Workings:

The entire tenor of OSP is set by the executive committee headed by Mr. John Crowley. Mr. Crowley depends heavily on personal meetings with individuals as primary sources of information. He constantly monitors the progress of projects and cross-checks information sources to evaluate the effectiveness of his organization structure. All contract decisions including make or buy and subcontract are made by Mr. Crowley. All communications (except security messages) emanating from OSP are signed by the responsible party and released by Mr. Crowley or in his absence Mr. McMahon. All hardware decisions not impacting the funding are made in the projects. The effectiveness of the OSP operation depends heavily upon: (1) the assignment of work related to the individual's ability to produce results and (2) the individual's capability to assume the initiative required by his position.

Each Program Director serves in the role of program manager responsible for the overall planning, coordination and ultimate outcome of his program.

The Management Control Center:

Although the OSP Management Control Center serves as a program status display room, it is more often used as a conference room. The charts and displays in the room reflect
25X1 the status of the [redacted] programs. In all of the meetings attended in this room, no one except Mr. Crowley really referred to any charts or displays in discussions of problems involved in program management. The individual program meetings conducted by the program directors are not held in the control center. The comment that we have a later or more recent figure than the one on the chart was frequently heard. There was no evidence of data management. Displays of the critical activities in each project were conspicuously absent.

25X1 [redacted]

This particular program is well into the production phase. The development phase was managed via PERT and transitioned into Line of Balance for production. [redacted] 25X1

maintains primary management control of this program and provides all data to support the project charts in the control center.

The 64 bar LOB chart in the control center is complimented by an Operational Schedule that displays major item status in a Gantt-type fashion.

All of the contracts are pegged to incentives that call for progress payments against deliverables. In fact, we pay actual costs incurred as reported by the contract negotiator and evaluation of cost data is not performed either by contracts or the project staff.

25X1 [redacted]

The agency contractor, originally was a 25X1 [redacted] with a successful record in small development. This contractor is not convinced that a program plan is necessary and has not produced an acceptable program plan. As late as [redacted] Mr. Crowley was convinced that had no control over the program and since has attempted to effect program management. [redacted] 25X1 25X1 [redacted] the OSP program director, cited the contractor's lack of capability to understand the system requirements and/or interface problems of a large system. Further evidence of this fact was found: (1) in the limited use of PERT, i.e. (2) the lack of synchronism between the PERT data and the biweekly progress reports, and (3) the inability of the project staff to relate costs to performance to schedule. This contractor is still operating under a letter contract and has recently reorganized in an attempt to effect better program control.

Manager for Program Planning and Control, reported on his planning efforts from mid-October to mid-November. The traditional cost and control charts were displayed for incremental program costs, cumulative program costs, direct material and labor costs and subcontracts. personnel discussed the various charts in detail.

In all of the research of this project, evidence of the relationship of systems management to system engineering and of the hard planning base required for large systems was conspicuously absent. Also, nowhere was a status of deliverable reports or data management presented or reported for or to the program.

25X1 [redacted]

This program involves [redacted] contractors with 25X1
25X1 effectively [redacted] different sets of data requirements. The contract and work statement both contain provisions for program documentation and program management plans that are effectively controlled totally by The contract contains provisions that changed pertinent documentation requirements of the work statement written for this program portion. Under this contract, government approval of program management documentation is not required. No justification is required for any change to deliverable PERT networks and renumbered activities are not coordinated with the project office. These actions have rendered PERT ineffective for the project staff. When network changes have occurred, this contractor has shifted his planning base to minimize the deviation effects. Although has over 3,000 cost cells, the contracting officer cannot prove the existence of product costs and does not believe that is product costing. A fact bearing on this statement is that each assistant program director has a bonus plan that is set as a percentage of the profitability of his work center. There is no motivation to relate performance to cost in this program and so neither the project staff, not the control center nor contracts is making such a comparison. Contracts feels it is the responsibility of the program staff and the control center. Such a comparison under the present data structure is a virtual impossibility because the financial data cannot be traced back or related to a work package breakdown of the constantly shifting PERT network. Even in the face of considerable overruns has not really conceded to providing the data necessary to effect OSP program management. Basically the contract language in the work statement covering program management documentation is weak. The documentation described in section 7.5 in the work statement does not require government approval and updating is as required. Section 6.14.1 states that milestone charts shall cover all key events, activity time spans, and their interrelationships. Such language not only reflects a weakness in the program requirements but also tends to reflect a attitude. An attitude that was initially displayed during contract negotiation when they would agree only to top-level network reporting during the negotiation.

The contract documentation requirements generally adhere
25X1 to the [redacted] requirements for Systems Engineering Management but the technical documentation requirements in the contract do not require customer approval for the major specifications.

The contract and work statement contain provisions for program documentation and program management plans. All of the contractually required documentation plans have been received, however, there was no indication that such plans had been approved by the government. is using PERT time to control schedules. The costs are not tied to PERT identified work packages. The financial plan described a task-based cost system which has been modified so that budgets are keyed to products. The contractually required documentation was not as comprehensive as the documentation, although it generally followed the documentation structure of the [redacted] 25X1 System Management Procedures.

The PERT documentation received by the project staff contained discrepancies between the networks and the computer run regarding the slack of the critical slack.

The contract is a very comprehensive construction contract and the management information reporting is tied to a CPM network. The network is referenced by job order numbers to monthly computer printouts of performance and construction costs. Costs are also structured by building and system. All invoices are checked against the fiscal reports by the facilities division. The facilities division not only analyzes all construction reports and data but also provides support to the TPA in maintaining the control center charts reflecting the performance status.

The only analysis of management and/or performance data is accomplished by the facilities division and this contract has been consistently on schedule and under the budget. All of the contracts including the construction contract and the majority of subcontracts in this program are of the Cost Plus Fixed Fee (CPFF) type.

Design and Analysis Division:

This division has well-defined functions and responsibilities supported by mission and task plans for individuals in the division. [redacted] 25X1 the division chief, maintains two division notebooks so that he knows who is working on what and is able to present a succinct status report in approximately 15 minutes.

It was noted that the functions and mission statements in the notebooks were not approved by the Director of OSP. Also, discrepancies were noted between the responsibilities described in the notebooks and the responsibilities described in the official office memorandum, its charter.

Program Administration Division:

This study concentrated on the management control center previously discussed and on contract administration, because these functions reflect the effectiveness of project planning and control. The three contract negotiators in the contracts branch are charged with the usual negotiation responsibilities including the liaison and coordination of contractual matters with Program, Project, Contractor and other personnel. The contract negotiators strongly influence the programs and the program management since they not only prepare and negotiate all contracts but also determine whether or not each particular cost is reimbursable to the contractor as an allowable item of cost in the administration of each contract.

The majority of contracts and subcontracts under OSP are of the Cost Plus Fixed Fee (CPFF) type.

Conclusions

A proposal describing a Management Information System Study was presented to the DD/S&T and approval was granted to conduct such a study within OSP. The primary purpose of this study was to demonstrate the feasibility of conducting a Management Information System study for the S&T Directorate by conducting such a study within the Office of Special Projects (OSP). Based on the analysis and findings, the following conclusions may be stated:

1. OSP operates in an atmosphere of tight centralized control of programs.

This type of control is largely due to the vagarities of OSP manpower, the nature and type of contracts, the sensitive nature of the program activities and the operational philosophy established by the Director, Mr. Crowley.

2. The Director of OSP, Mr. Crowley, uses actively an informal type of communications network which depends heavily on personal contacts and meetings with individuals as primary sources of information.

This type of operation is largely due to the fluid nature of the various programs within OSP, the vagarities of OSP manpower, and the level of control desired by Mr. Crowley.

3. The Management Control Center operates as a program status display room and does not function as an active control center.

Every Monday program review meetings are conducted by the program managers for Mr. Crowley. These meetings concentrate on the most current technical problems with a review of actions in being and actions to be taken by program personnel. In all of the meetings attended, no one except Mr. Crowley referred to the displays and charts.

Program personnel exhibited a lack of confidence in the data displayed since the comment that we have a later figure than the charts was often heard. Such is the case when the TPA's rely upon official data and project personnel have access to informal data long before such data becomes formalized. This situation is further compounded since the lack of interest by program personnel does not motivate the TPA's to insure that such displays are kept current.

Thus the Management Control Center does not function as a control center since: (1) it has not been the focal point of current information and (2) no one analyzes the data available to ferret out potential problems.

4. There is a wide range of understanding of the Systems Engineering Management Process.

This wide range of understanding is reflected by the variations in the contractual documentation that is required and/or exists from contract to contract and from program to program. This is further evident in the individual projects not adhering to some defined, generally acceptable singular process that provides guidelines and guideposts as a type of checklist for program managers. Such variation does not provide the necessary base to: (1) effect systems management and (2) assess the effectivity of program management.

The transitional phases between the conception, definition, acquisition and operation of a system pose problems not so much in what to administer but rather in how to administer the systems engineering management process.

Such an atmosphere lends itself to responsibility overlaps and gaps between the members of a Program Management team.

For example in the [redacted] there is an apparent lack of overall program management responsibility. This is confounded by the lack of a definitive specification

25X1

and work statement for the contract effort with . This contractor is still working under a letter contract which is now going into the 17th month. ASPR indicates that definitization of a letter contract should be made prior to the expiration of 180 days from date of contract or 40 percent of the production of supplies whichever occurs first. However, there is a "flexibility" addendum given saying that in "extreme" cases an additional period of time may be authorized. Although has established work breakdowns and PERT networks in some areas of effort only on there is a lack of total program planning in evidenced by:

1. the absence of adequate planning documentation including PERT networks

2. the need for CIA project staff to spend time redefining work statements,

3. the piecemeal approval of costs as a result of inadequately defined program plans,

4. the lack of an overall program budget,

5. the use of milestone schedules on facilities as a basis for measuring progress and payment with no indication of monitoring of facility progress related to system requirements and

6. the amount of effort and time spent in educating this contractor in systems management. This contractor is not convinced that a program plan is necessary and has yet to submit an acceptable program plan to the Program Director.

25X1 In the [redacted] the only integrated PERT network for the entire program exists in the control room and this network has not been communicated to the participating contractors.

5. There is a lack of understanding of capabilities and limitations of various management control techniques.

An important objective for any management control technique is the ability to relate schedule, cost, and performance. PERT as an effective technique must have a data base that provides status reporting of schedule, cost and performance. The PERT data available to the TPA's only conveys schedule information. Cost data flows to the TPA's from a separate data source. Aggregate relationships are assembled but clear data audit trails do not exist. Analysis of the PERT data is not accomplished, and the predictive features of PERT are not fully utilized. Cost and time are

not related at a work package level and performance measures are not reported. Tracking of just schedule and cost--planned and actuals do not provide the necessary insights for effective management control. Meaningful answers to such important questions as: How much overrun now? How far behind schedule now? What elements or parts are causing the schedule and cost problems? Are we getting the same schedule and cost information available to the contractor on this program? are not forthcoming because the necessary data base requirements contractually are weak. Effective program control cannot be exercised since OSP program management has not rigidly specified its requirements and the reporting requirements contractually were left to the discretion of the contractor. Contractors have reported against a constantly shifting planning base without reporting against their original estimates. Such tactics minimize the deviations of actuals to planned values and preclude the effectiveness of any analysis of such data. Further, the data reported on computer runs has not agreed with the data on network drawings and in other cases does not have the same time reporting period.

25X1

As an example, in the [redacted] (contractor) could and did generate changes in PERT details which would remain hidden as potential causes of overruns or schedule slippages and not appear on the summary charts until a significant point of accomplishment was close at hand. Comparisons of actuals to the revised plan always appear more optimistic than the comparison of actuals to the original plan. Unless the original plan is maintained, then effective control is lost because the ability to predict overruns and compute the value of work performed is destroyed. Contractors' management must know and be held accountable for a measured return on investment. Additionally, unless the same planning base is used consistently, the differences in the actual to plan deviations could and did become the center of heated controversies and strain of contractual relationships.

Since (contractor) is not required contractually to produce Equipment Status Reports, slack sorts and other types of normally defined PERT outputs, the TPA cannot accomplish the necessary analysis of the PERT data for the Program Director or Associate Directors charged with the management responsibility of the program. The contractual reporting requirements are weak and do not provide sufficient information for control.

The PERT runs received from did not corroborate the slack times shown on the network displays even though both documents contained the same effective date.

25X1

In the [redacted] the schedule planning covered the time frame only up to scheduled CDR's and still does not cover the entire program. Within there is still a lack of understanding of management control techniques for the same reasons cited under conclusion #4.

25X1

In the [redacted] although LOB is effective for production efforts, the "development" difficulties have pointed up the following deficiencies in technique.

Although LOB does consider a loading between related tasks, the technique lacks predictive features with which to point up trouble areas. The inability of the technique to adapt itself to uncertain time estimates or to changes made in time estimates made during the course of the program generates a problem for those using LOB and more specifically for those responsible for maintaining LOB displays. Since the real milestones lie at or with the integration phase, the bar allocation seems out of line in relation to the problem areas.

6. There is a proliferation of CPFF contracts in relation to available OSP manpower.

Under CPFF, motivation to (1) estimate accurately and (2) plan and control tightly is lacking for both the contractor and the government. CPFF contracts require numerous auditors, technicians, and inspectors to effectively police such contracts. The manpower resources of OSP are being spread too thin to effectively police CPFF contracts.

25X1

In the [redacted] all of the "prime" contracts 25X1 and the majority of the subcontracts are all CPFF. Even the facilities construction contract [redacted] is a CPFF contract. Such work is normally contracted fixed price with time-related monetary penalties for late completion.

25X1

In the [redacted] the existing letter contract is no more than a CPPC type and the majority of subcontracts are or will be CPFF.

25X1

In the [redacted] all of the contracts are of the incentive type. The reporting from contractors on costs and work progress apparently is related to well-defined costs and work packages set at negotiation. Incentives tend to eliminate the motivations for overrun usually attributed to CPFF contracts, however, there is no guarantee that overruns cannot occur.

Recommendations

The findings and conclusions of this study provided the basis for the following recommendations:

1. That OSP undertake a redefinition of management responsibilities and authorities to eliminate any overlaps or misunderstandings that have developed in the rush of solving daily problems.

Since a management information system must provide relevant information to decision makers, then clearly defined and understood areas of responsibility must be a prerequisite to the implementation of an effective management information system.

2. That OSP undertake an internally prepared and presented management development program covering large systems management, the systems engineering management process and the effective use of management systems in program management.

Since there is a wide degree of understanding in this area, such a program would provide a rapid and a long range payoff because the knowledge gained could be put to use immediately and on future programs.

3. That OSP shift resources to the OSP Management Control Room to undertake a planned effort to develop a program predictive capability in concert with current program status information for all OSP programs.

Such an effort should be directed toward establishing the control room as the management information hub for all projects and programs assigned to the office. The control center must contain the latest official and unofficial information such that project personnel would become dependent upon the control center for the latest information. As prerequisites to this effort, the existing program information requirements must be strengthened to provide the necessary data flow into the control room with unimpeded access to the control room assured for all programs.

4. That OSP make a concerted effort toward effecting incentive contracts in development programs.

All development programs reach a point in time when the probability of success becomes reasonably assured. When

that point is reached, the application and acceptance of incentives is more reasonably assured. The standard argument of only CPFF for development programs places the government in a weak position since the multitude of resources required to effectively monitor a large program are not economically feasible. For those programs requiring state of art breakthroughs, a transition from CPFF to CPIF can work toward reducing overall program costs. Incentives provide a profit motivation for contractors and demand of the government more intensive scrutiny of proposal cost estimates submitted for negotiation. Effective analysis by the government minimizes windfall profits inherent in padded estimates that remain unchallenged by government contract negotiators and price analysts.

5. That Contracts Branch prepare and present a seminar on (1) incentive contracting and (2) the process of negotiation for the OSP Project Staffs.

Such presentations would develop a deeper understanding of the contractual relationship requirements, the interrelationships of program management and the contracting process, and the importance of planning by the government for negotiation.

6. That OSP provide selected individuals with short-term, one-time specific training programs related to specific assignments such as PERT for TPA's and Program Managers.

Such training would assure that management information and control techniques would be used within their full capabilities and limitations.

7. That OSP effect a shift of program resources from engineering the system to system management of the program.

Such a shift will mark the effective interrelationship of the program management with the management information system of an operational management control center.

8. That OSP rename the OSP Management Control Room to the OSP Management Information Center.

Such an action will remove the psychological stigma of the word control. As a word, control tends to have a specific meaning that detracts from the purpose of a management information system.

9. For future programs, OSP must emphasize the importance of the work statement, the specifications, and the contract to the program management team.

A concerted effort by a program management team in the preparation of these documents can eliminate many problems for that program.

The program management team must give more emphasis to the definition of program management requirements in contractual documentation with particular attention to the planning and control information and report requirements.

10. That OSP explore the possibility of utilizing the IBM 360 PMS (Project Management System) on existing and future programs.

This conprehensive modular computer program incorporates interrelated time, cost, and manpower data for project planning and control. The program provides the flexibility of report generation on a random and/or routine basis and the ability to vary the amount of detail contained in such reports.

11. Many of these recommendations involve simultaneous changes in management processes and in information and must be carefully coordinated.

Information systems are related to organization structure since information is the basic ingredient and product of communication and decision-making of management. Information systems cannot be treated as a separate entity.

DDS&T

MANAGEMENT INFORMATION SYSTEM

STUDY

PHASE I

THE OFFICE OF SPECIAL PROJECTS

(OSP)

APPENDIXES

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DATED FEBURARY 20, 1968

MANAGEMENT OFFICER
DDS&T

APPENDIX A

MANAGEMENT INFORMATION SYSTEMS [1]

Management systems may be subdivided into two general types: Resource Systems and Information Systems.

Resource systems are concerned with people, material, and capital. These resource systems produce either goods and/or services, i.e., other resources to satisfy the wants or recognized needs of society.

Information systems deal in meaningful or useful data that represent the resources of the resource system. Management depends upon the information produced by the information system to manage effectively the resource system.

Since information is an abstract representation of resources and since resources in terms of total utility to the customer involve time, place, form, and possession utilities, in like manner the value of information to the manager involves time, place, form, and possession value.

Managers do plan, organize, and control the performance of resource systems and depend upon the nonseparable function of communication via information systems to accomplish the decision-making function. The higher the management echelon, the more dependent is that echelon upon information because it is further removed from the resources for which it is accountable.

> The ultimate goal of an effective management information system is to keep all levels of management completely informed on all developments in the business which affect them. To do this, the data processing personnel and those entering information into the system should know exactly what data to collect and which data to tabulate, and management on its part has the obligation to be able to write down its actual requirements for internal information.[2]

[redacted] STAT

[2] James P. Gallagher, Management Information Systems and the Computer (New York: American Management Association, 1961), p. 17.

Defining the Management Information System

When an electronics engineer designs a total electronic system, his first task is to define the desired outputs of the system and the required inputs to the system making it possible to generate these outputs. The design of this complex system is generally done in its broadest concept in terms of black boxes. The design problem resolves the inner detail of the black boxes in such a manner that they have the proper transfer characteristics required by the input and output specifications. The design job can then be broken down into the various levels of detailing the black boxes. The process of analysis and the building of models of management systems can be done in analogous fashion to designing done by electronic engineers.

Levels of Indenture

"There are three divisions whose presence is universal in any organization: production, distribution, and finance." [1]

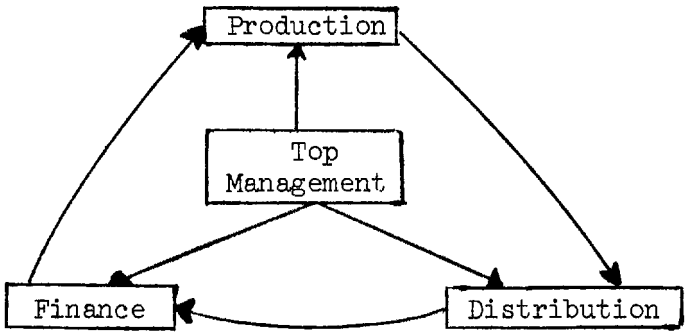

Figure 1. The Organic Functions Cycle

According to Davis, these are called organic business functions, an analogy taken from physiology, since the absence of any one of the functions would cause the death of the organism or the collapse of the concern. Within these organic business functions, the management functions of planning, organizing, and controlling must operate and are accomplished by each functional manager. Top management must not only plan, organize, and control the enterprise by managing groups but must also plan, organize, and control the dynamic factor interrelationships between functions.

[1] Ralph Currier Davis, The Fundamentals of Top Management, (New York: Harper and Bros., Publishers, 1951), p. 207.

For the management levels within each organic business function there exists a major cycle of activities and within it a composite of indentured or layered minor cycles of tasks and operations.

> If we are to build an information system capable of meeting the requirements of . . . a modern business, we need to know the anticipated range and intensity of all items of data which may be introduced into the system . . . . The design of an adequate system presupposes a very complete knowledge of short and long-term plans, and of the creative potential of the business.[1]

If the information system is to provide information to the manager for control, then it must be well planned. An approach to planning is to view the organic business functions as cycles and to determine if such cycles contain the elements of control. "The function of control is to correlate and coordinate action in accordance with a plan." [2] "Control depends fundamentally upon a comparison between the results attained and the goals (or objectives) sought. There can be no concept of control without goals, objectives, expectations, or plans concerning the outcome that the operations should produce." [3]

The function of control is not only dependent upon planning but also upon the function of organizing. If resources cannot be organized according to the specifications in the plan, either the planning goals or the resource specifications must be modified or the control elements will be ineffective. Control in turn serves to determine whether the plans are being adhered to and acts where necessary either (1) to bring results into conformity with plans or (2) to generate a need to replan. These alternatives tend to increase the precision of the control process. The first exerts a force on the factor of actual accomplishment with a "conform-to-the-plan" effect. The second exerts a force to modify the factor plan with a "conform-to-the-actual-accomplishment" effect. These interrelationships may be graphically portrayed.

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1 Lionel E. Griffith, "An Outline of Organization for the Vice President/Director of Administration," Shaping a New Concept of Administrative Management (New York: American Management Association, 1961), pp. 34-5.

2 Davis, p. 630.

3 E. Wainright Martin, Jr., Electronic Data Processing (Homewood, Illinois: Richard D. Irwin, Inc., 1961), p. 19.

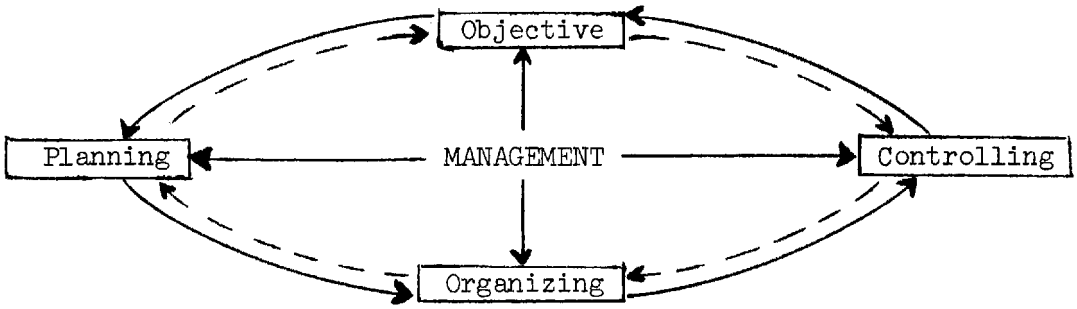

Figure 2. The Management Functions Cycle within each Organic Business Function

Once the information has served the control function, it may then be used as a basis for future planning by validating or refining the goals originally established in a prior planning cycle. This cycle is also subject to management by exception.

The important point that must be recognized is the existence of an on-going process. Even as economics deals with an on-going concern so management deals with an on-going process. Any business viewed as an on-going process will continue to survive so long as it provides the values demanded of it by the society in which it exists. Within the on-going process, information cycles can be identified for each function at each level of management. These information cycles must be properly interrelated between the levels of management they serve. Each information cycle must be designed to meet the management information requirements at each level. Thus integration of information cycles can be accomplished when such cycles are properly interrelated and when the entire information structure rests on the broad base of information cycles at the lowest level of the organization.

This recognition of information cycles inherent in the management process can be diagrammed as shown in Figure 3. Once management has reviewed its control reports, such reports may influence changes in management decisions and/or in the various plans. In this manner, implementation of established objectives or goals for each level of management can be evaluated if the information cycles are so time phased with operations that current and factual reports are generated. To accomplish this analysis phase, all business operations must be described in some systematic way.

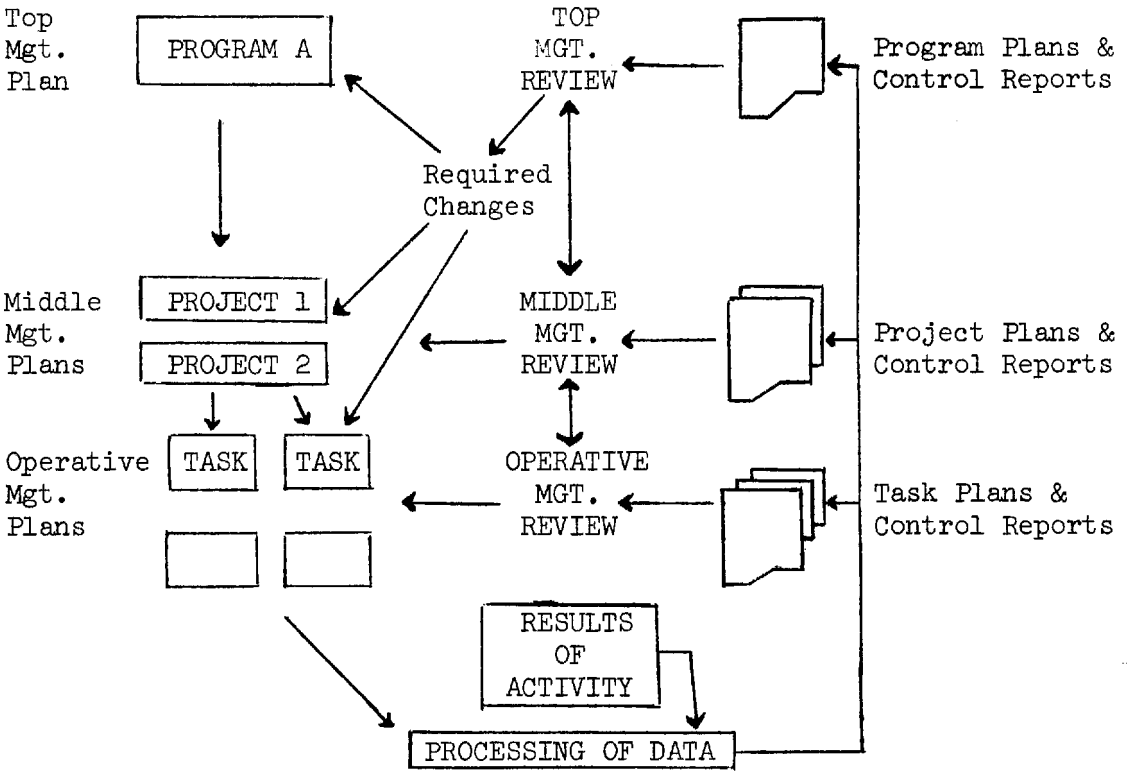

Figure 3. The Information Cycle

Some Realities of Information Systems

Often systems analysts whose experience has been in certain phases have difficulty accepting a broader concept of systems and fail to project their thinking into larger systems. The trend to think of a computer when systems analysis is mentioned often leads to the mechanization of established procedures that may be useless and outmoded for current management needs.

There are certain dangers or realities of systems that management and the systems analyst both must recognize in the analysis and design of management information systems.

The Computer Complex

The computer today has become a management status symbol in many instances. This is particularly noticeable at conferences and seminars where the participants tend to rank themselves by the size of computer in use in their organizations. Whether their information systems require a computer or whether the computer is used effectively in no way affects such ranking. In some instances, just having the largest

computer on order is enough to place that representative in first place in the hierarchy. Using the computer as a management status symbol usually produces a chaotic search by the systems analyst for applications for the computer soon to be delivered. The results of such an illogical, irrational approach are poorly designed systems, automation of existing but obsolete procedures, and high operating costs.

The MIS Plan

The absence of a set of finite rules often subjects the systems analyst to conflicts between system boundaries, the degree of information integration, and the diverse demands of management for information. These conflicts can be minimized by top management development of a master plan of the component information systems with their data interrelationships discretely defined for the total information system of the enterprise. The component information systems should encompass related management activities in manageable segments such as payroll and personnel, requirements planning and raw material inventory control, or product distribution and production.

Systems Criteria--A Management Responsibility

As every weapon system must accomplish some set of operating requirements or system criteria, so must every information system accomplish its set of operating requirements or system criteria, such as providing management with timely, accurate, and concise information for control. These information criteria must be defined in quantitative terms to facilitate the measurement of system performance. In either case, the responsibility for establishing the list of criteria for each system is a responsibility of the system purchaser. The system purchaser of a management information system is management; therefore, management is responsible for establishing systems criteria.

A more subtle aspect of the criterion problem is the danger that the criteria adopted for a lower level system may be unrelated or inconsistent with higher level criteria. For example, management must not (1) measure the inventory system on the number of dollars invested if the entire distribution system is measured on some level of customer service or (2) measure the computer center on tons of paper printed if a management information system is measured on the accuracy and timeliness of relevant management information.[1] Such inconsistent criteria usually generate unnecessary conflicts.

[1] For a more detailed explanation see: Roland N. McKean, Efficiency in Government through Systems Analysis (New York: John Wiley & Sons, Inc., 1963) Chapters 1 and 2.

Concept of the Inventory of Resources

"Management often wants a management information system for the purpose of aiding the decision-making process. However, when the analyst tries to find out what information is required, at what levels, and by what managers, he often finds that management hopefully expects to be told what information they require to make valid decisions."[1]

The purpose of this section is to provide some meaningful information design criteria for the analyst who finds himself in the position of being such an internal captive consultant to management.

The concept of the inventory of resources and its information design criteria have evolved from the traditional economic factors of production and the concept that information is abstract representation of economic resources.

The organic functions of any business can be portrayed as a cyclical flow. Extending this concept, one can say that every functional manager is responsible and thus accountable for some combination of resources by which he is able to meet the demands of his customers. Resources, according to the earlier classification, include people, material, and capital; and customers may be internal and/or external to the organization.

The production manager, for example, with his accountable inventory of resources must meet the internal demands for goods imposed by the distribution manager. The ability of the production manager to meet these demands is directly related to two limiting factors: (1) the nature of the demands imposed by his customers for his goods and (2) the inventory level of resources allotted to him. In a similar fashion other managers, such as the accounting manager, the sales manager, the office manager, the personnel manager, and the transportation manager, deal with their accountable inventory of resources to meet the demands of their respective customers.

In order to manage this inventory of resources effectively and efficiently, the manager must be provided with information that compares the present and future status of his inventory in relation to the present and projected customer demands. Inventory status as used here means the operational condition of the inventory of resources.

There are three basic actions that affect the operational condition of any inventory of resources: (1) additions to the inventory of inputs, (2) changes in form or place called status changes, and (3) deletions from the inventory or outputs to meet customer demands. These basic

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[1] Daniel W. McElwee and James E. Fernandes, A Software Primer for Managers (Washington, D.C.: Industrial College of the Armed Forces, 1963-1964), p. 3.

actions, together with the form, time, place, and possession utilities of the resources, provide a foundation for some management information criteria. These information criteria devolve from a basic management information need that every manager have access to information that reports the identification, the location, the quantity, and the quality of each of his allotted resources with respect to time in each of the three basic action areas. This operational condition of the inventory represents the status of the accountable manager's inventory. If such information is to serve a control function, each element or set of information that describes an actual condition must be compared to the previously planned condition. Therefore, "with respect to time" as used here includes not only current status compared to current demands but also future status compared to projected demands.

An effective analysis of any information system requires an intensive and thorough study of such information needs for every management position at all management levels involved or affected by the information system under study. The results of such a study must include the determination of what information is needed, by what activities or functions, in what form and sequence, at what points in time, to make what kinds of decisions. The analyst must study not only the continuity of information flows but also the nature of each managerial decision if he is to be able to provide managers with information they require to make valid decisions. The concept of the inventory of resources is an important keystone in the practical application of this philosophy of management information systems because the concept identifies the general information requirements of management. The next step is to build a model of the information system that blends into one analysis all of the responsibilities, authorities, information requirements and data processes of a management information system.

Appendix B

Program Management

Program management is resource management of the most complex form because it deals with the problems of government-industry program management.

Program management involves the appointment of one man, the program manager, who has responsibility for the over-all planning, coordination, and ultimate outcome for the program. He is usually superimposed upon the functional organization, and the imposition of this integrating agency tends to create new and more complex organizational relationships. The special role of the program or project manager, which differentiates him from the traditional manager may be summarized as follows:

1. As a manager he is concerned with accomplishing specific projects that require participation by organizations and agencies outside his direct control.

2. Since the project manager's authority cuts through superior-subordinate lines of authority, he conflicts with the functional managers who must share authority in their functional areas for the particular project.

3. As a focal point for project activities, the project manager enters into on an exception basis those matters necessary for the succesful accomplishment of the project. He determines the when and what of the project activities: the functional manager, who supports many different projects in the organization, determines how the support will be given.

"Managing a Program

The accomplishment of a program cannot be judged by the rate of expenditure of money but by the achievement of successful events. We can spend or obligate money like mad, but if certain things do not happen successfully at the time that they should occur, the project is sick. Down to the smallest act which, if not performed, will cost precious time to accomplish, the project manager must know what is to happen, when it must occur, and who is responsible. By an infinity of means he can assure himself that it is happening when it should. Note the stress on 'is happening' not 'happened'. Highly successful project management depends upon the manager knowing in advance whether a scheduled accomplishment is or is not likely to be on time. The whole gamut of reporting means, from personal visits to PERT, is of less than effective value unless there is a yellow light far enough in advance of the red light of danger to permit taking action--bringing additional resources to bear on redirecting effort--in time to keep the main stream flowing on schedule.

One of the most prevalent and most dangerous threats to successful project management is the human tendency for everyone--scientist, designer, engineer, or personnel recruiter--to keep his problems to himself until it is too late to correct the situation, even with intense application of effort and resources. This enemy must be fought every hour of every day. The manager must instill confidence that the provision of help based on a confession of difficulty will not bring criticism or castigation. Here machines and canned techniques cannot help--only people and personal relations. Costs, must, of course, be kept under control in proper fashion. The measure for this is also in the anatomy of the project schedule we have reviewed. However, cost is a consequence, not a cause, and the schedule of events is the only really effective measure of final results. If the schedule gets out of whack and cannot be enforced, costs will go off as an absolute consequence. If the cost schedule is adhered to with finality and the events do not occur the project is still a failure.

As with a doctor, the project manager's duty is to keep his patient healthy at all times and to see to the curing of incipient infections before they spread and become critical. To accomplish his mission he needs to know that he starts with a fully developed structure and that some important organ is not missing. He must be intimately familiar with every part and piece of that structure. Given the proper professional background, his probability of success is dependent upon the quality, reality, and completeness of the original anatomy--the complete project schedule.

The project manager must know that the health of the patient can and must be determined constantly by the measure of the pulse, the heartbeat, and the temperature. The pulse of his project is the measure of events by time, not by money and man-hours, which are only part of the complexion, the surface. The heartbeat is the pace and rhythm of the endless small contributory tasks, each of which is essential to the whole. Finally the temperature cannot be taken by a thermometer, but involves the skilled day-to-day evaluation of the existence (or lack of it) of that nameless, indefinable feeling of confidence, smoothness, assurance, cooperation, and purpose that must permeate a project organization to assure its permanent health and well-being. That evaluation is still a product of experienced management intuition and can never be computerized.

The right way is a lot of fun and produces immense satisfaction. The wrong way produces ulcers, heart attacks, and financial losses. If all projects could start with a strong and complete anatomical structure, they could be managed with confidence."[1]

[1]Maj. Gen. J. B. Medaris, "The Anatomy of Program Management," Science, Technology and Management. New York: McGraw Hill Book Company, Inc., 1963, pp. 127-128.

The System Engineering Management Process[1]

Systems engineering is basically concerned with deriving a coherent total system design that meets stated objectives. The interplay between the system engineers and the engineering design specialists requires the closest coordination and is a major management problem which must be recognized and solved. Although no two systems are ever alike in their development requirements, there is a uniform and identifiable process for logically arriving at system decisions regardless of system purpose, size, or complexity. This process begins with development and spans the system life cycle.

The system engineering management process includes the early identification of (1) the system objectives, (2) the "design to" requirements necessary to meet these objectives, (3) the "build to" requirements which describe the configuration of the system to be delivered and (4) the requirements for personnel, training, procedural data, and logistical support.

System engineering management is usually initiated in the latter part of the Conceptual Phase and continued through the Definition Phase, Acquisition Phase, and early Operational Phase of the system. This entire management process depends upon the ability to establish and maintain a system of documentation for positive identification and effective control between interface requirements, design requirements, and design solutions of the elements within a system and between systems. The use of uniform documentation, engineering reviews, and standard procedures can assure an orderly transition from one major commitment point to the next in the system engineering process. This transition is guided and monitored by three basic engineering reference points, i.e.: Program Requirements, Design Requirements, and Product Configuration. The Conceptual Phase generates defined Program Requirements. Upon approval of Program Requirements the Definition Phase generates defined Design Requirements. Upon approval of the Product Configuration, the Acquisition Phase continues from first item acceptance through turnover of last item to the user.

[1]Abstracted from AFSCM 375-5, System Engineering Management Procedures.

In this manner, these three reference points represent the progressive and evolutionary development of specifications and associated data. Since specifications evolving from the general to the specific provide the standards for design, a level of control must be maintained via a constant closed-loop relationship between the system and design requirements and the total system requirements.

Contractural and Program Relationships

Information accuracy and data flow are affected by the contractural and program relationships that emerge from the organization structure established for each program.

The government/single prime contractor relationship allows a relatively uncomplicated data flow, shown in Figure 1, since most subcontractor's PERT will be processed by the prime contractor and integrated with his data into a single set of reports. In this case the government agency with primary program responsibility must integrate a small amount of data from the participating government agencies and the occasional associated contractor who does not report to the prime contractor.

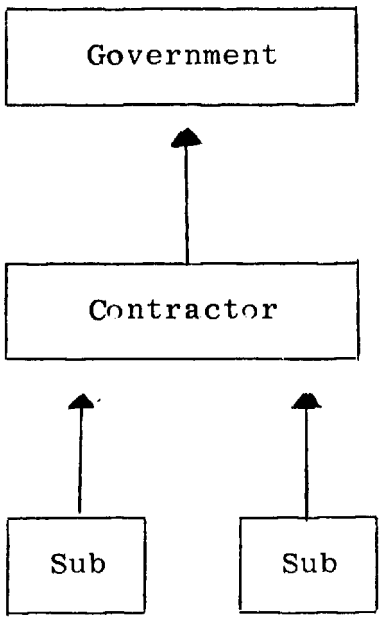

Figure 1. PERT Data Flow

When a number of contractors are involved, then either one contractor is given the responsibility for Network Integration or the government must assume this responsibility as shown in Figure 2.

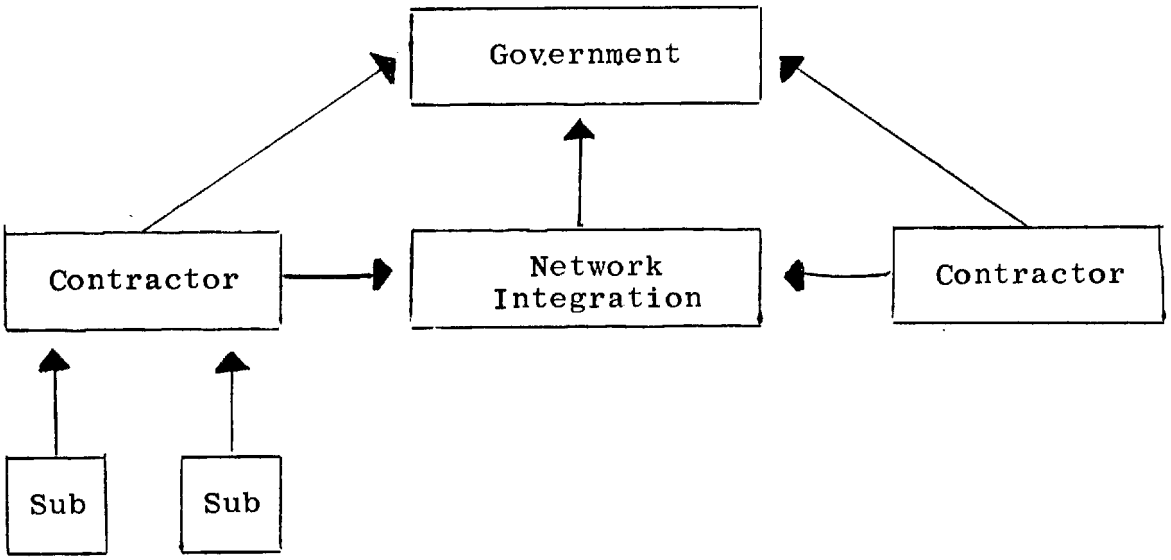

Figure 2. PERT Data-Flow

When many organizations are involved in a program, as shown in Figure 3, data integration becomes more difficult and may affect the timeliness of the reported data or the ability to merge data easily or both.

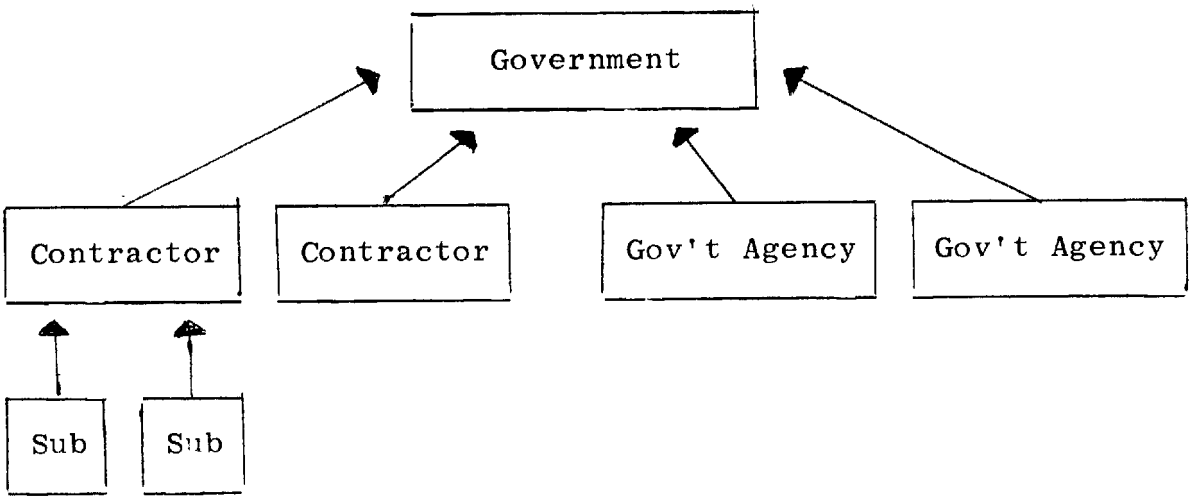

Figure 3. PERT Data-Flow

Obviously one government agency has been designated as the program manager with responsibility for program network integration. When data passes through several levels of organization, the reliability and timeliness of PERT data are affected. Direct reporting techniques such as the Rainbow Reporting Procedures may be justified.

The relationship between System Engineering and Program Management is that Systems Engineering insures that the product or end item meets the performance specifications while Program Management in addition must insure that the product is produced within acceptable costs and delivery schedules. It is during the Conceptual Phase that a product-oriented, work-breakdown structure is established and modified until an acceptable structure and level of detail has been reached. Prior to the initiation of procurement action, a Program Management Network prepared by the Government Program Management Office based on the work-breakdown structure establishes the plan for the Acquisition Phase. To be most effective, all of this planning must be completed in advance of the preparation of Request for Proposals or equivalent procedures so that interfaces and other important data may be included and provide guidance to the contractor. The contractors' proposal is thus tied to the basic work breakdown, and contract negotiations can focus on work packages.

The Contracting Process

The contracting scale runs from Firm Fixed Price contracts (FFP) at one end to Cost Plus Fixed Fee contracts (CPFF) at the other end. ASPR 3-402(6) revised in March 1962 states: "The firm-fixed-price contract is the most preferred type, because the contractor assumes full contract responsibility, and the relationship between cost control and profit dollars is established at the outset of the contract . . . . Its use will provide the contractor with a maximum profit incentive to control costs of performance. However, . . . in certain situations, the use of special contract incentives may be more appropriate."

As early as 1936, the Nye committee reporting on the CPFF contract system observed: " . . . there is absolutely

no effective control of costs possible, without a huge policing system of auditors and inspectors constantly on the premises."[1] In 1963, Mr. McNamara stated: "The increasingly complex weapons systems resulting from the technological revolution of the 1950's led to a great expansion in the use of cost-plus-fixed fee (CPFF) contracts. However, both Department and industry officials agree the CPFF contracts not only fail to provide incentives for economy, but actually deaden management efficiency by removing the need for either the Department or the contractor to estimate costs accurately, and to plan and control programs tightly."[2]

Concerning the CPFF, the ASPR states: "This type of contract normally should not be used in the development of major weapons and equipment, once preliminary exploration and studies have indicated a high degree of probability that the development is feasible and the government generally has determined its performance objective and schedule of completion. . . . In contracting for advanced development work, an incentive contracting arrangement is preferred."[3]

In order to use incentives in contracts, the nature and extent of the work to be accomplished must be more rigidly defined than under a CPFF contract. Within the limits of the contract statement of work, the government must protect itself against the award of incentive profits at the expense of quality. The Incentive Contract must not become a trade off of shoddy workmanship for incentive profits. The relationship between cost reduction and workmanship is clearly sharing cost incentive with the government in that the contractor keeps 100% of every dollar saved. Detailed specifications in which performance, schedule, quality and reliability parameters are described establishes a high-cost risk go or no go incentive for the contractor under FFP. Just as the FFP provides 100% contractor cost risk at one end of the contract spectrum and the CPFF provides 0% contractor cost risk at the other end such that degress of contractor risk

[1]Senate Report No. 944 Pt. 4, 74th Congress, Second Session (1936) 324, p. 312.

[2]Secretary McNamara's First Armed Services Progress Report to President Kennedy, July 8, 1963.

[3]ASPR 3-405.5(c).

exist between these two contract types, so there are degrees of work statement and specification definition across the same spectrum. With complete detailed definition at the FFP end the spectrum narrows to relatively little definition at the CPFF end. The incentive contract falls between the FFP and the CPFF in both cost risk and degree of definition. A multiple incentive contract presents a wide variety of possible outcomes to the contractor and allows the government to remove itself from the decision-making process so as not to interfere with the contractor's choice of alternatives which will maximize the contractor's profits. A properly structured incentive contract insures that the contractor would be motivated during contract performance toward the set of objectives desired by the government. The unique feature of the incentive contract is that the options or choice of alternatives is left to the contractor. This feature is not found in the FFP and the CPFF in which the contractor has little or no choice as to the nature and quality of performance under the contract. Under the FFP contract performance beyond the minimum acceptable levels, not required under contract, would not be rendered in most cases by the contractor since the precise performance result is foreordained when the contract is signed.

Under the CPFF, the precision of specifications, drawings, delivery date, and statement of work is generally lacking. With an obviously imperfect and necessarily imprecise description of the end item, the contractor commences work toward an objective described in a performance specification. Under the direction of the government at every step of his labor, the contractor is subject to control and surveillance over his efforts. If the government does not emerge from a CPFF contract with precisely the end product it wants, it has only itself to blame because of its failure to give explicit directions and guidance in the course of contractor performance. The CPFF differs from the FFP not in the degree of instruction given to the contract but rather to the time and method of giving the instructions. In the FFP, the instructions are given with the FFP request for proposal. In the CPFF, instructions are given during contract performance as well as at the start of the contract.

Since OSP is involved in a majority of CPFF contracts, two aspects of such contracts must be considered, i.e.: (1) the impact of constructive changes and (2) overrun tendencies.

Constructive Changes -- For many years government contracting officers had the power, under the changes clause in government contracts, to make virtually any changes in specifications within the scope of the contract. Within the general scope of the contract, the variety of changes the contracting officer is empowered to make under the changes clause is almost infinite. It is not a problem with formal changes but rather with a particular class of change called a constructive change. "A constructive change is a request of an informal nature by the contracting officer or his representative for additional work over and above that required by the original contract. It differs from a formal change order in that it is not labeled 'change order' and the contracting officer may stoutly deny that any change to the contract was ever intended. Nevertheless, requests in letters, telegrams or conversations may constitute constructive change orders . . . . What are the types of constructive change orders? First, any request however informal, for additional work over and above that required by the original contract may be a constructive change order. Then there are specific types: acceleration; a direction to proceed in accordance with defective specifications; erroneous interpretations by the contracting officer requiring additional work; limitation of the contractor's work method; excessive inspection requirements; improper rejection and rework."[1]

CPFF Overrun Tendencies -- The theoretical explanation of overruns is that the contractor under a prospective CPFF knows there are no inhibitions inherent in the contract against a possible human tendency to underestimate the dollar amount of the contract and/or overstate the possible performance characteristics and the delivery time of a system. Such overoptimism might better the contractor's change of selection and/or enhance the budget approval of the project. Ultimately, if the actual costs exceed the original estimates, it would not be to the detriment of the contractor's profit picture under a CPFF.

Additionally, because of the fixed overhead, CPFF's placed where a mix of fixed and/or incentive contracts exists, could be treated by the contractor as CPPC, Cost Plus Percentage Contracts, where the contract "mix" could induce the contractor to gain greater actual profit on his

[1]F. Trowbridge vom Baur, "Differences Between Commercial Contracts and Government Contracts," American Bar Association Journal, Vol. 53, March 1967, p. 250.

fixed price and/or incentive contracts by overrunning his cost-type contracts. The tendency of some contractors to expand the dollar volume of their business activities, since success is guaged by expanded gross sales as well as increased profits, especially when involved in new or growing endeavors. Share of market is always a medium range objective just as profit may be a short range objective.

Appendix C

Use Of PERT As A Management Information System

A management technique or device must be an integral part of the management process. Logically, therefore, in any discussion of any of the techniques such as PERT, a review of the underlying management process will provide the foundation for analysis and evaluation of the utilization and effectiveness of PERT.

The function of management involves the continuous, intelligent direction of people by determining and communicating the primary and secondary objectives of the organization. This function by its nature includes the development and utilization of an integrated time-phased plan of action, demanding reasonable requirements in the way of resources and the subsequent balancing of resources as they are made available and used. The basic steps of this process are:

1. The determination and effective communication of the primary and secondary objectives.

2. The development of a coordinated plan of action for the accomplishment of the objectives.

3. The conversion of the plan into integrated schedules within allocable resources.

4. The regular reporting and concurrent evaluation of progress against the scheduled plan of time and cost estimates.

5. The recycling of this process to incorporate a desired new action into a new cohesive scheduled plan.

All organized activity must have as its motivating and guiding force the attainment of some predetermined objective or objectives. Given the objective, then planning sets the nature, sequence, and interrelationships necessary to achieve that objective by defining the structure and relationships of units of required effort. Planning considers and answers questions of capability by determining in-house versus subcontracting effort and establishes the feasibility of meeting the directed due date for successful achievement of the objective. A broad operating plan, to be used by top management, must have realistic requirements consistent with available resources and time. The planning function at each level sets forth the important objectives of the kind, quality, and quantity for the work to be accomplished. If this planning is not accomplished,

there can be no assurance of a coordinated, balanced use of resources. The bridge between planning and effective, coordinated implementation is scheduling. Scheduling considers the competition for resources within and between programs, produces a time-phased plan consistent with desired completion dates, and serves as the basis for continued evaluation of program progress. Progress evaluation requires regular, continuous, evaluation of actual performance against current scheduled plans and the detection and isolation of significant deviations from the scheduled plan as a forecast of time and cost overrun.

The principle of significant reporting, which focuses attention on the significant deviations from the scheduled plan, only requires detailed analysis of the specific problem covering: (1) What remedial action is being taken and by whom? and (2) What results may be expected and when?

Programs can be managed most effectively only if managers have a common framework from which to plan and to control the schedules and costs of the work required to achieve the performance objectives. Managers at all levels need techniques at all stages of a project to:

1. Define the work to be performed.

2. Develop realistic estimates based on the resources planned to perform the work.

3. Determine where resources should be applied to best achieve the time, cost, and performance objectives.

4. Identify developing problems in time to permit corrective action.

The PERT technique in its entirety (time and cost) establishes a sound base for effective scheduling, costing, controlling and replanning. It is flexible and can be tailored to the specific work to be managed and the manager's need for information.

The most effective use of PERT requires the existence of the following elements:

1. management policy and procedures for the operation of the PERT system;

2. an orderly definition of the objectives in the form of a product-oriented, work breakdown structure;

3. a specification for each end-item subdivision of the work-breakdown structure;

4. an account code structure which establishes number codes for the charging and summation of costs;

5. the work packages[1] required to complete the objectives;

6. a network flow plan that consists of the activities and events and displays the interdependencies and logical planned sequence of accomplishment to reach the project objectives;

7. expected elapsed time estimates for activities and identification of critical paths in the networks;

8. a schedule for the accomplishment of the work efforts required to achieve project objectives that is based on the network plan and resource availability;

9. cost estimates for the work packages associated with the end-item subdivisions of the work breakdown structure;

10. budgets keyed to work accomplishment and task schedules;

11. analysis of the interrelated networks, schedules and slack values as a basis for evaluation of project status, forecast of overruns and underruns, and the identification of problem areas in time for management to take corrective action;

12. summary reporting to meet the varying cost and schedule information requirements for the different levels of management;

[1]The work required to complete a specific job or process, such as a report, a design, a documentation requirement or portion thereof, a piece of hardware, or a service. A work package may consist of one or more cost significant activities. The content of a work package may be limited to the work which can be performed by a single operating unit in an organization or may require the contributing services of several operating units. The overall responsibility for the work content of a work package should be assigned to a single organization or responsible individual. It is the lowest level of cost collection and is represented by a charge number related to a single summary number. In this way, the work package couples to the cost accounting system through the charge number, and to the PERT network through the beginning and ending event numbers of the package.

13. continued forecasting through simulation of the effects of both planned and actual decisions and actions on the total project.

The program planning begins with the development of the product-oriented, work-breakdown structure. The end items[1] objectives of the structure are broken down into lower level end items subdivision, then subdivided into the tasks required to accomplish them. These tasks are called "work packages." When the work packages associated with each individual end item are identified, flow plans in the form of networks for the corresponding parts of the program can be constructed. Network activities are identified with the work packages they represent. Separate cost estimates are not necessary for each activity in the work package since this could result in excessive detail and unrealistic accounting effort. Each work package will normally be represented by one or more activities. The beginning and ending of the work package can be identified by the first and last events in time associated with this work package. The estimates are analyzed to eliminate unnecessary manpower costs and premium payments for materials and services. For example, the estimated monthly manpower requirements can be totaled by skills and examined to minimize needless overtime and hiring caused by unrealistic requirements. Therefore, manpower redistribution is accomplished by the judicious scheduling of slack activities when possible. The summarization of the work packages into an overall plan can then be costed and compared to a proposed schedule plan.

After a scheduled plan has been prepared, a firm cost estimate is developed for each work package. This cost is based on the resources required to perform the work package within its scheduled time. Summarization up through the work breakdown structure provides cost estimates for each end item and for the total program.

The PERT system requires periodic evaluation of:

- estimated, budgeted, and actual costs for each work package;
- estimated and actual time of each work package and associated activities.

[1]The term "end item" is used to represent the hardware, documents, services, equipment, or facilities that are deliverable to the government or that are a commitment on the part of the supplier.

This comparison significantly improves cost and schedule control by establishing the cost and time status of the program and identifying any potential cost overruns and schedule slippages for work in process. Estimates of the cost and time needed to complete work not yet started are also obtained in order to predict future schedule slippages and future cost overruns. This enables the identification of difficulties in the performance of critical work in sufficient time for corrective management action.

The level of detail to which it is desirable to apply PERT is largely a matter of judgment, and varies from program to program, from one part of a program to another, and from the proposal preparation stage to the execution stage of the same project. Effective results from PERT depend on judicious application in depth and breadth relative to the characteristics of the program. Programs with significantly more complex variables of performance, cost and schedules should receive a broader and deeper application than other programs. Where uncertainty of program output does not exist, other conventional systems may be desirable.

Generally, managers at any level want only the information from PERT which concerns their activities and responsibilities. Reports to management may be presented graphically, orally, written or in any combination of these three forms. In summarizing information for display purposes at higher management levels, the following guidelines should be observed:

1. Graphic displays are preferable to tabular numerical values that require study and analysis.

2. All management levels require timely, clear and concise summaries on the overall program status. Specific levels need summaries of their specific areas of the program.

3. The information should be predictive as well as historical, and should be developed only to the level of detail essential for apprising specific levels of management.

Reports To Management

Periodic management reports make it possible for managers to anticipate cost overruns and underruns.[1] An example is the Management Summary Report (Figure 1) which shows the overall

[1]A detailed discussion of reports is contained.

CMWS - AIO MISSILE	REPORTING ORGN.	CONTRACT NO.	REPORT DATES
	XYZ	61-9865	TERM (SPAN): TOTAL PROJECT CUT OFF DATE: 31 MAR 63 RELEASE DATE: 10 APR 63
LEVEL SUMMARY ITEM: 1/MISSILE			

ITEM	COST OF WORK $(000)						SCHEDULE			REMARKS
	WORK PERFORMED TO DATE			TOTALS AT COMPLETION			MOST CRIT SLACK (WKS)	COMPL DATE	S - SCHED COMPL DATE -- } TOTAL ITEM A - ACTUAL COMPL DATE -- E - EARLIEST COMPL DATE -- } CRITICAL ITEM: L - LATEST COMPL DATE --	
	VALUE	ACTUAL COST	(OVERRUN) UNDERRUN	PLANNED COST	LATEST REVISED EST	PROJECTED (OVERRUN) UNDERRUN			P YR 63 JFMAMJJASOND 64 JFMAMJJASOND L YR	
LEVEL 1 MISSILE 302	31,000	32,300	(.04) (1,300)	48,000	51,400	(.07) (3,400)	-8.0	29 MAR 64 01 FEB 64 10 MAY 64	E L S	
LEVEL 2 PAYLOAD 302DEV121	13,300	13,200	.01 100	16,700	16,700	--	-1.3	22 OCT 63 12 OCT 63 12 OCT 63	E L S	
LEVEL 2 FLIGHT CONTROLS 302DEV122	3,700	4,000	(.08) (300)	5,600	6,100	(.09) (500)	-2.2	13 DEC 63 29 NOV 63 20 FEB 64	E L S	
LEVEL 2 MISSILE BODY 302DEV123	1,100	1,100	--	4,200	4,000	.04 200	1.2	01 JAN 64 10 JAN 64 10 JAN 64	E L S	
LEVEL 2 PROPULSION 302DEV124	4,400	4,900	(.11) (500)	8,600	9,600	(.11) (1,000)	-8.0	29 MAR 64 01 FEB 64 01 FEB 64	E L S	
LEVEL 2 INSTRUMENTATION 302DEV125	3,100	3,100	--	7,200	7,200	--	0.0	10 MAY 64 10 MAY 64 10 MAY 64	E L S	
									TIME NOW	

FIGURE 1. PERT MANAGEMENT SUMMARY REPORT

schedule and cost status of both the program as a whole and of each of the major component items. It also indicates the problem areas that require management attention.

The Report provides each manager with the following information relative to his areas of responsibility:

- the cost overrun or underrun to date (a measure of cost performance), through a comparison of the planned costs with actual costs for the work performed;
- the projection of total cost overrun or underrun which is obtained by comparing a planned cost with the latest revised estimate for the work segment or program;[2]
- the amount of schedule slippage is indicated by the difference between the established schedule and the earliest scheduled completion date;
- the identification of trouble spots - that is, identification of those areas of the program where the cost or time status requires management attention.

Management Summary Reports are prepared for managers at each level of the program structure. Each Management Summary Report will normally be accompanied by a brief written analysis. One report is prepared, for example, for the entire System (level 0) based on the product-oriented work breakdown structure shown in Figure 2. At level 1, a similar report is prepared for each major element of the program, such as Facilities, Missile, Training Program, Guidance, Systems Integration, etc. At the next lower level, level 2, the major elements of the program are subdivided again and a Management Summary Report is prepared for each manager to whom responsibility is assigned. The Missile, for example, is divided into elements such as Propulsion, Payload, Missile Body, Instrumentation, etc. The Missile Body is further subdivided and management reports are prepared at such lower levels of the program as are considered necessary by the program manager. In analyzing the status of a program, the responsible manager would examine the reports for those end items where trouble is indicated. He would then refer to the lower level reports as required to isolate the trouble. These reports present back-up detail for all levels of management summary report in various analytical formats.

[2]The planned cost and latest revised estimate will include approved but "still-to-be" negotiated changes within fund limitations.

WORK BREAKDOWN STRUCTURE, LEVEL 4

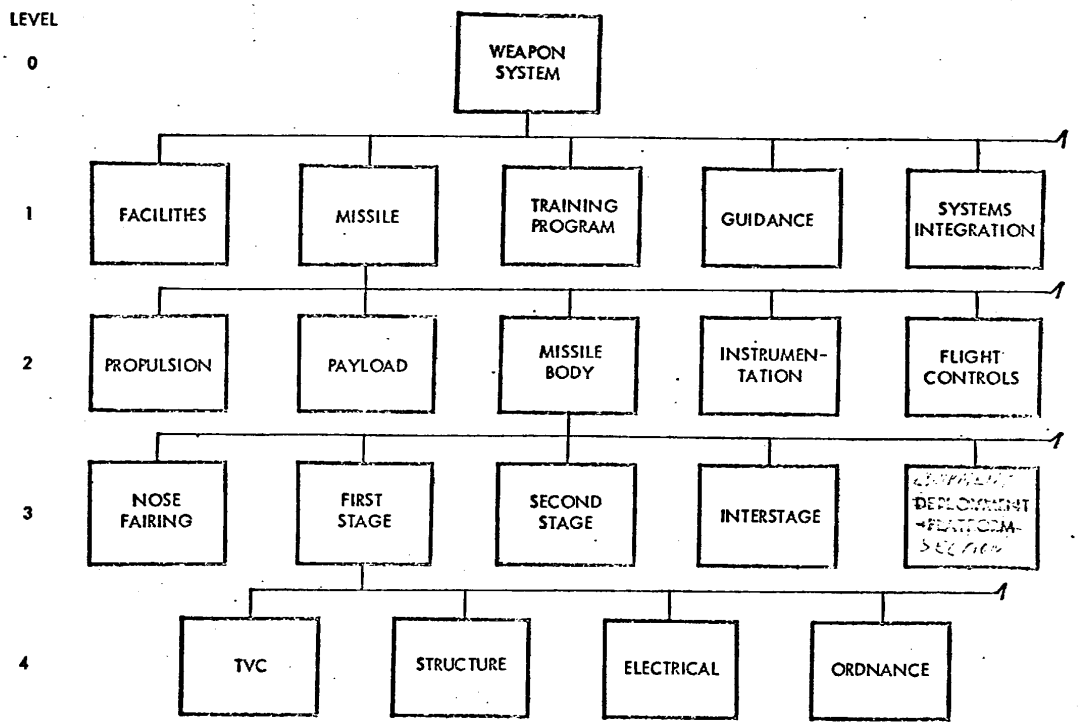

FIGURE 2.

Another management report is the Cost of Work Report which shows the appropriate manager:

- the planned costs to perform the work;
- the actual costs to date;
- the value of work performed to date;
- the projection of costs to program completion, based on actual costs to date and the latest revised estimates for work not yet performed.

A comparison of the actual costs to date and the value of work performed to date will show whether the work is being performed at a cost which is greater or less than planned. Figure 3 illustrates an example of the Cost of Work Report.

The Cost Outlook Report (Figure 4) and the Schedule Outlook Report (Figure 5) show the trend of successive monthly projections of the time and cost to complete the work. Each month, new projections are obtained and these projections provide new entries for the Cost and Schedule Outlook Reports.

The manager can obtain these reports for the total program or any element of the work breakdown structure. By relating the trend of these projections to previous management decisions, the manager can observe the effects of these decisions on the cost and schedule for the project. He can determine, on a month-to-month basis, whether or not the actions taken to control schedules and costs are producing the desired results.

The evaluation of these reports enables a manager to take any of the following actions within his area of responsibility:

- adjust the schedule of slack path activities to minimize the need for overtime or additional hiring;
- redistribute funds from areas of underrun to more critical areas;
- revise the planned resources for work packages by:
  - trading off interchangeable resources between critical and slack path activities;
  - increasing or reducing the planned resources for activities.

COST OF WORK REPORT

PROGRAM	REPORTING ORGN.	CONTRACT NO.	REPORT DATE: 3/31/63
CMWS	XYZ CORP	61-9865	TERM: PROGRAM
LEVEL/SUMMARY: 1/MISSILE			CUT OFF DATE: 31 MAR 63 RELEASE DATE: 10 APR 63

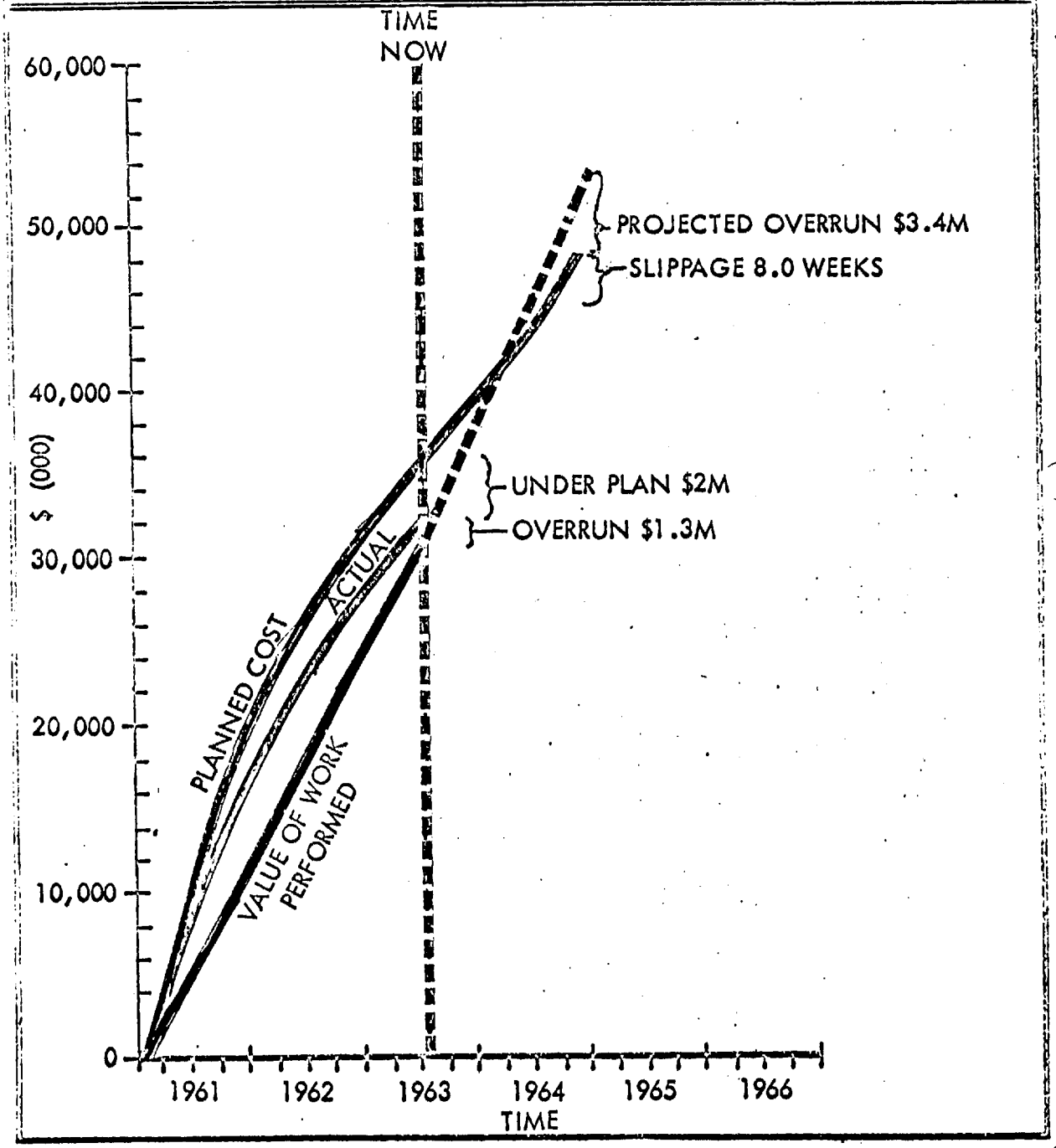

FIGURE 3.

COST OUTLOOK REPORT

PROGRAM	REPORTING ORGN.	CONTRACT NO.	REPORT DATES
CMWS - AIO MISSILE	XYZ CORP.	61-9865	TERM (SPAN): TOTAL PROG. CUT OFF DATE: 31 MAR 63 RELEASE DATE: 10 APR 63
LEVEL/SUMMARY ITEM: 1 /MISSILE			

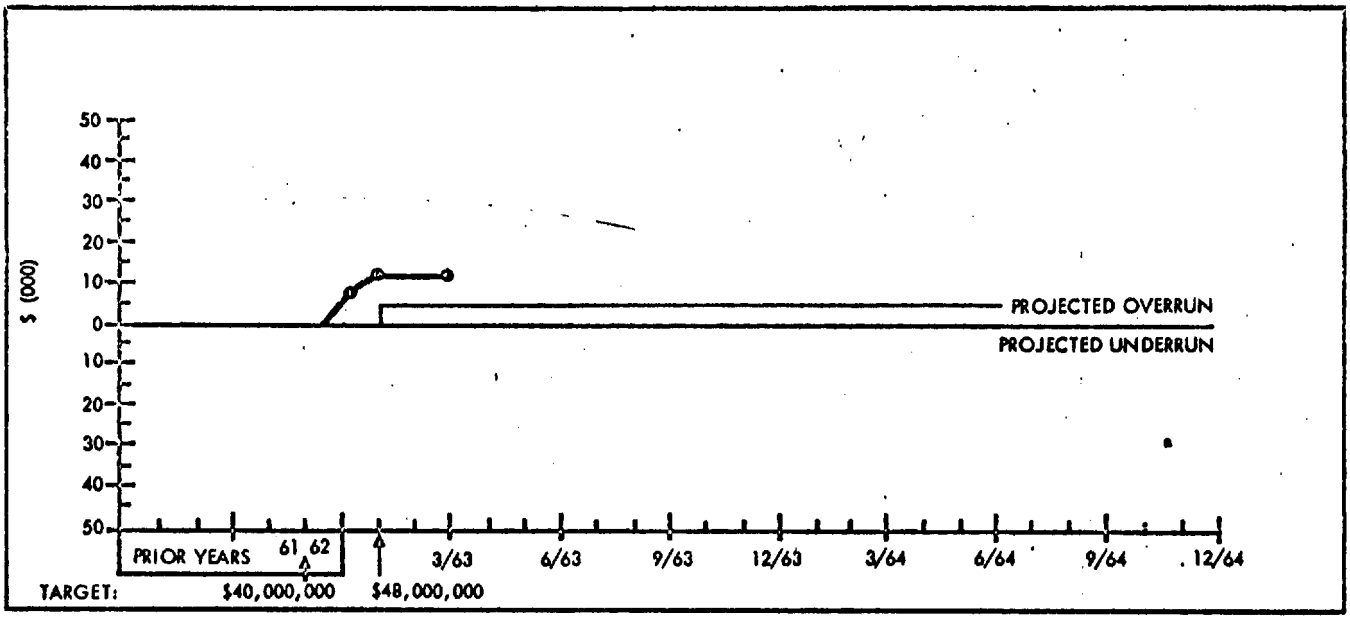

FIGURE 4.

SCHEDULE OUTLOOK REPORT

PROGRAM	REPORTING ORGN.	CONTRACT NO.	REPORT DATES
CMWS AIO MISSILE	XYZ CORP.	61-9865	TERM (SPAN): TOTAL PROG. CUT OFF DATE: 31 MAR 63 RELEASE DATE: 10 APR 63
LEVEL/SUMMARY ITEM: 1 /MISSILE			

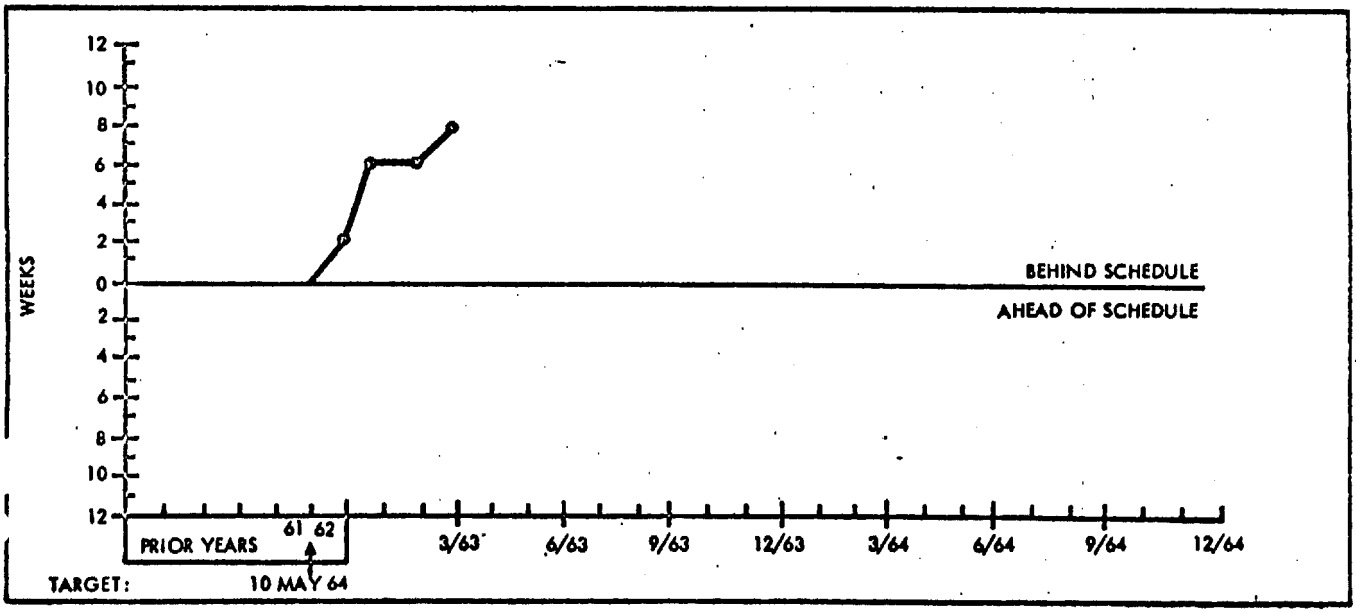

FIGURE 5.

- revise network sequence or content by:
  - employing a greater or lesser amount of concurrence in performing activities;
  - modifying the specifications or methods of performing the work, thereby altering or deleting or adding activities.

Since the actions that management takes to correct problems often involve revising plans, schedules, and budgets, provision is made in PERT for necessary recycling through use of the simulation process. The process of simulation of alternative courses of action can be carried out at any point in the management process cycle by any level of management.

PERT is a management tool which, when used by a manager:

- measures accomplishment against current scheduled plans and objectives;
- assists in identifying real time requirements and provides limits for detailed scheduling;
- fixes responsibility and assures continuity of effort despite turnover in personnel, either executives or operating personnel;
- is a discipline which assures complete program coverage and provides visibility from the total program objective down to the lowest supporting task;
- spots potential future problem areas in time for preventive action or for improvement;
- uses the management by exception principle in reporting to higher levels of management;
- permits essential rescheduling and provides periodic evaluation of plans;
- provides capability for consideration of trade-offs in funds, manpower, performance, and time between critical and non-critical areas of effort as a means of improving schedule and cost situations for one or more programs;

- makes it possible through its simulation techniques to evaluate and forecast outcome of alternate plans before implementation. Simulates and measures the effect of proposed changes in scheduled plans and permits an early identification of the most efficient plan when parallel approaches are used;

- provides historical data banks for the programs which can be drawn upon for new programs.

Report To The Analyst

The standard computerized PERT Output Reports as a minimum should include:

1. An Event Report--sorted by event number sequence and expected date (chronological list of events) sequence.

2. An Activity Report--sorted by ending event sequence, beginning event sequence, expected date (chronological list of activities) sequence and slack sequence (negative to positive).

3. The Program/Project Status Report--provides information similar to that of the Management Summary Report and contains more detail needed for the analyst.

Effective analysis of PERT data prior to presentation of information to management is one of the keys to the successful application of PERT. The computer program can do little pre-analysis and computer outputs contain only raw data or partially interpreted data. The function of the analyst is to analyze the data, establish the status of the program, and present this status to the program manager to enable him to accomplish his decision-making function.

Some problems are of such a nature that they are not apparent until reports are merged at the government or integrating contractor level. Other problems, visible at the contractor level, should be well documented in the Problem Analysis Report which the contractor forwards to the government.

The complete array of reports are not required and the appropriate level of reporting must be selected carefully. For example, the Management Summary Report generates information for end-item subdivisions and can be used by managers at all levels.

Cost management reporting involves costs generated in the work package, the work package summed into its parent lowest level end-item subdivision, and automatic summarization up through the various work breakdown levels. In addition to end-item reporting, there may be a need for management to review costs by function or organization. A Cost Category Status Report meets this need by relating work packages or elements of cost within work packages to the specific cost categories identifying the function or organization segments. Summation of such costs does not distort the work breakdown structure. PERT does not require the contractor to develop a new cost accumulation system although some modification may be necessary to his current estimating and budgeting system. Indirect costs are added to work packages when permitted by the existing accounting procedure or required by contract. All other indirect costs are prorated at the summary level. Data submitted to the government should include all cost.

Cost Application And Control

The budgeting of costs by only calendar time period does not provide an adequate base for measuring cost performance. To provide a realistic base and accurate information low-cost, well-defined, short-term work packages are essential. Industry has utilized such combinations for many years in efficient dealings with its subcontractors.

The work package serves as the basic unit for:

1. estimating costs,
2. establishing budgets,
3. accumulating actual costs, and
4. comparing actuals and estimates with budgets,
5. writing the task description and
6. authorization of work.

Of major importance to the accuracy of information is the size of the work package. A valid work package cost variance can be determined only when the work package has been completed, so that its total actual cost can be compared with its total budgeted cost. In each report period, an estimate of value is made of the completed portion of each in-process work package.

This value is computed using the estimate-to-complete for the work package. Since such estimates are not perfect, they introduce some error. Short work packages are advantageous because at any particular reporting date:

1. a greater percentage of the work accomplished is represented by completed work packages for which valid cost variances can be established and

2. the estimates-to-complete errors will be smaller since fewer in-process work packages are involved and the estimates are made for smaller increments of future time.

Thus, the accuracy of cost performance is inversely related to work package size. A target for most work packages is a maximum of $100,000 and three months, with clearly defined and recognized tasks. Thus, the level of detail is a function of the technical complexity, dollar value, significant milestones and degree of accuracy desired by management.

Cost estimates loosely related to the specific work to be performed can outwardly satisfy the requirements of PERT. By counting organization personnel and multiplying by the scheduled time duration of the work package, the manhours and cost represent only the payroll to be covered and do not reflect the actual manhours required to accomplish the work package. This practice will render PERT or any other technique ineffective for generating basic source data to measure cost and performance.

Program Control

Program control is exercised by Program Managers through effective program appraisal and review reporting generally labeled monthly progress reports. Two of the key elements of such reporting are cost and schedule performance. What may not be as widely understood is the futility of trying to judge development performance (1) from only a cost performance report or (2) from a cost report generated out of a traditional functional structure and a schedule report generated out of a product or end-item structure (PERT-time).

For example, if a contractor is having difficulty and in reality overspending and behind schedule, the cost performance report would show actual expenditure either below or equal to planned expenditure and if far enough behind schedule traditional accounting methods will show an underrun instead of an overrun. Further, the schedule report would not readily disclose the

behind schedule condition if (1) the network activities were monitored at some aggregate work breakdown level or (2) reported against a dynamic network or (3) reported in a summary Gantt-type structure. In such cases, particularly in development programs, the final development article will very probably be delivered late and the final program cost will exceed the budget. Well-documented studies have drawn attention to the uncertain nature of cost and performance predictions in CPFF weapons systems. In the Peck and Scherer study[1] actual development costs averaged 220% higher than original estimate and ran as high as 600% on one of the twelve development programs studied. The actual time exceeded time estimated by 36% on the average, with one program as high as 230%. Of the 12 development programs, four were carried to production and production costs exceeded original estimates by from two to 10 times. Other studies conducted by Rand Corporation have produced similar conclusions regarding overruns in development programs.

The application of PERT in its entirety (time and cost) provides a management system that directly relates schedule performance to time performance for development efforts, because information is generated out of a common base and structure. For example in Figure 6, the comparison of actuals to planned costs indicates a traditional $300,000 underrun. However, a comparison of value of work to actual cost reveals that $200,000 too much was spent and that actually a $200,000 overrun exists. If, in fact, the contractor was underspent by $300,000 then the time span between the planned and actual costs indicates a nine-month schedule slip. Since time lost on a development program represents work not accomplished, then additional costs will be incurred to accomplish that work. The program, as a result, will very likely suffer a nine-month slip and an overrun. The estimate to complete extension of the actual cost curve indicates a $200,000 overrun and a nine-month schedule slip.

PERT in its entirety provides (1) relevant information to the Program Manager so that the Manager can exercise effective control, (2) provides a common logic to both industry and government, thus facilitating communication and performance evaluation and (3) provides a meaningful "rate of return" measure via the value of work performed.

[1]See Merton J. Peck & Frederick M. Scherer The Weapons Acquisition Process Harvard University, 1962.

COST OF WORK REPORT

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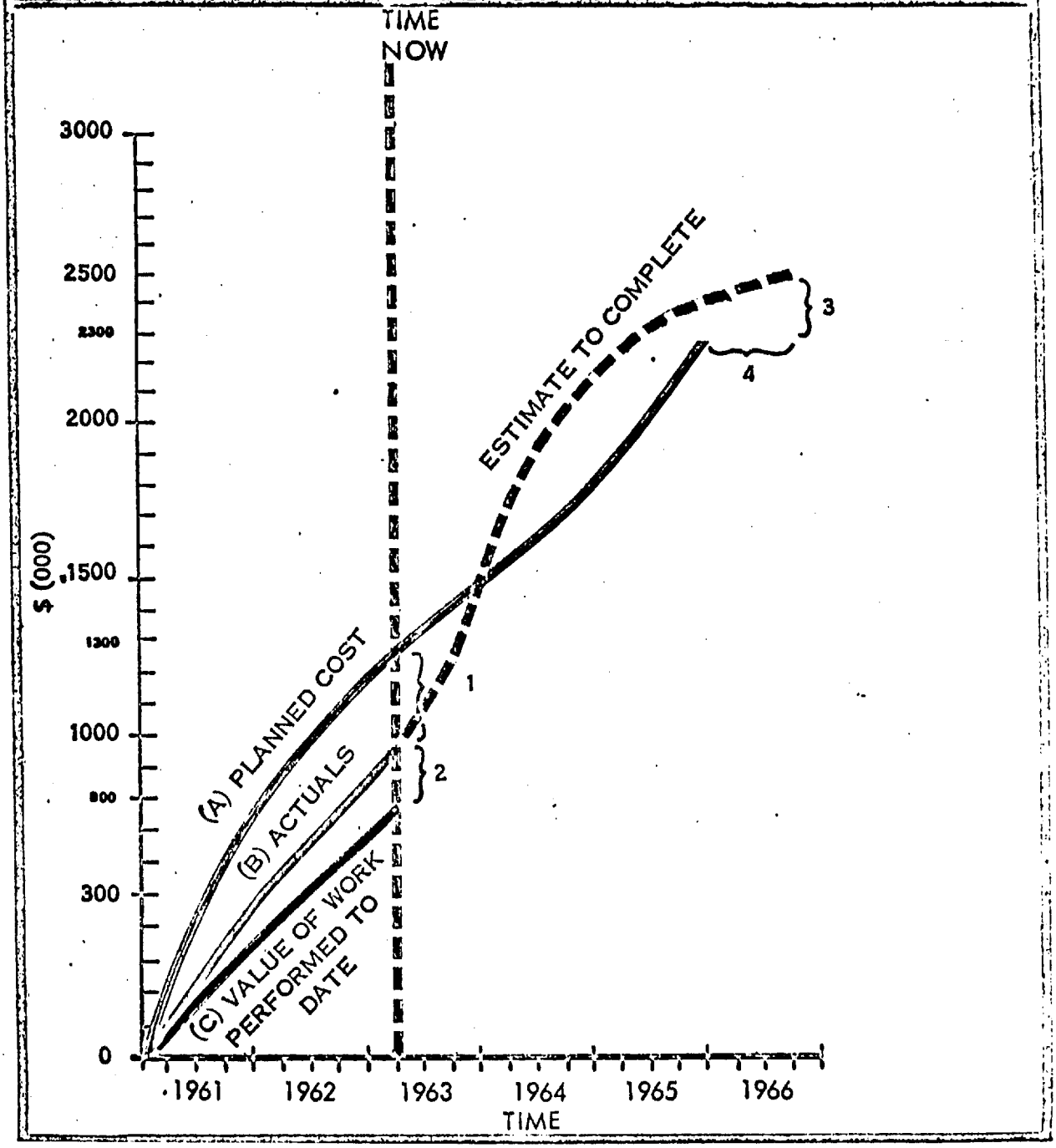

FIGURE 6.

Reporting Frequency

Due consideration must be given to the reporting interval or frequency by operating management. A bi-weekly reporting cycle is quite common, although weekly and monthly cycles are often used. The performing levels and middle managers may require more frequent reporting than top level management. The frequency of reporting may be influenced by the following:

- requirements of the customer;
- program duration;
- magnitude and complexity of the program;
- criticality and dynamic nature of the program;
- time required for data processing;
- degree of detail in the report;
- status of this program in relation to other priority programs.

Progress reports must be timely in relation to the cut-off date used in preparing reports. An indication of an approaching problem today is more valuable than a detailed blueprint of the situation weeks later.

Information Center

An information or management center can serve a variety of purposes, such as a display room for program status and outlook, a conference room, a means of keeping participants aware of the need for the review and control functions of management, or ideally, as a complete coordination, communication, and evaluation center for program managers. Management in government and industry typically has found it desirable to hold weekly briefings. Higher levels of review are conducted on a monthly and on-call basis.

Presentations in the information center should be timely and concise and should employ the most efficient communication techniques. The various levels of managers responsible for the work should explain the significance of any change from plan and its effects on the ultimate objective. It is their responsibility to provide appropriate and meaningful information for management review and decisions by distilling information transferred up from working levels of management.

Visual aids in the form of PERT outlook reports, or similar briefing charts, films, and other appropriate materials should be utilized during the briefings. This serves to illustrate problem areas quickly and thus avoid lengthy discussions concerning the definition and relationships of these problems. Physical progress of important installations, assemblies, etc., can be demonstrated by weekly photographs. On other charts, color codes or other related devices should be used to highlight any planned or scheduled event which may potentially delay or impede the program. This might include such things as labor, material, and funding shortages, as well as technical difficulties.

Regularly scheduled meetings conducted within an information center provide continuous effective communication. As a meeting place for responsible managers, their key assistants, and representatives of higher and lateral authority, the information center can provide an effective means for periodic transfer of information to assure program integration. It can serve as the focal point where management can bring together results from channels of reporting, key participants, and higher levels of management for program review. Executive attention can be drawn to actual and potential problems, alternative or recommended solutions, policy decisions, problems of coordination, or any other situation which requires higher level management decision or action. Major problems requiring action on the part of higher or lateral authority can be identified and communicated to those involved. On-the-spot decisions can be made and communicated to those responsible.

Decisions and observation of the program manager and other key personnel are recorded and subsequently transmitted to those responsible for action. The immediate objective of these meetings is to correlate all efforts and keep them moving toward the program objective, thus assuring that effective and efficient control over the program will be maintained.